SHURE

ELECTROMAGNETIC COMPATIBILITY LABORATORY
TEST REPORT

TEST REPORT TITLE: Electromagnetic Compatibility Tests of the Shure ULXD1 Digital Wireless Transmitter in the J50A Band (572MHz to 608MHz, and 614MHz to 616MHz)

TEST ITEM DESCRIPTION:

The Shure ULXD1 is a digital wireless microphone transmitter.

For: Shure Incorporated
5800 West Touhy Avenue
Niles, IL 60714

Project ID Number: SEL-043/ULXD1 J50A FCC15C

Date Tested: February 26 thru March 8, 2019

Test Personnel: Jamal Qureshi, Juan Castrejon, and Craig Kozokar

Test Specification:

IC RSS-GEN – General Requirements and Information for the Certification of Radio Apparatus
IC RSS-210 - License-exempt Radio Apparatus (All Frequency Bands): Category I Equipment
FCC Title 47, Part 2.1051
FCC Part 15C, Section 15.236(g)
FCC Part 15C, Section 15.236(d)(1)
FCC Part 15C, Section 15.236(f)(1)
FCC Part 15C, Section 15.236(f)(2)
FCC Part 15C, Section 15.236(f)(3)

TEST REPORT BY:	Craig Kozokar	Global Compliance Engineer	3-15-2019
APPROVED BY:		Engineer Project Managing, G.C.	3-15-2019
	Signature	Position	Date

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LIST OF APPENDICIES

APPENDIX	TEST DESCRIPTION
A	Necessary Bandwidth, Frequency Offset, Maximum Bandwidth
B	Radiated Spurious Emissions
C	Maximum Rated Power
D	Frequency Tolerance
E	Conducted Spurious Emissions at the Antenna Port

REPORT REVISION HISTORY

Revision	Date	Description
0	March 15, 2019	Initial release

1. INTRODUCTION

1.1. Scope of Tests

This report presents the results of testing per FCC Part 15C, Section 15.236(g), Section 15.236(d)(1), Section 15.236(f)(1), Section 15.236(f)(2), Section 15.236(f)(3), FCC OET Basic Certification Requirements for Wireless Microphones, FCC Part 2.1051, RSS-Gen, and RSS-210. The following data was taken following the measurement method as described in the document section(s) listed on page 1 of this document. Provided is the data for the test sample. Also included is a summary of the measurements made and a description of the measurement setup. The test samples meet the requirements of the above standards. The equipment under test (EUT) contained a transmitter that was designed to transmit in the UHF TV frequency bands shown in Table 1.

Model	Band	Frequency (MHz)	Output Power (mW)
ULXD1	J50A	572 to 608	1, 10, 20
ULXD1	J50A	614 to 616	1, 10

Table 1. EUT Frequencies and Power Levels

1.2. Purpose

This series of testing was performed to determine if the test item would meet the requirements of FCC Part 15C, Section 236(g), Section 15.236(d)(1), Section 15.236(f)(1), Section 15.236(f)(2), Section 15.236(f)(3), the FCC OET Basic Certification Requirements for Wireless Microphones, FCC Part 2.1051 RSS-Gen, and RSS-210.

1.3 Deviations, Additions and Exclusions

None

1.4 EMC Laboratory Identification

The electromagnetic compatibility tests were performed at the Shure Electromagnetic Laboratory, Shure Incorporated, 5800 West Touhy Ave, Niles, Illinois 60714-4608. This laboratory is registered with Industry Canada as Site # 616A-1. The Shure Electromagnetic Laboratory is accredited by the National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP).
The NVLAP Lab Code is: 200946-0.

1.5 Summary of Tests Performed

The following electromagnetic compatibility tests (Table 2) were performed on the test item in accordance with ETSI specifications.

Table 2. Summary of tests performed

FCC Part 15C Test Spec	Description	EUT Firmware	Tested Frequency in MHz	Appendix	Test Results
15.236(g)	Necessary Bandwidth	2.2.24	572.000, 589.925, 607.875, 614.125, 615.875	A	Pass
15.236(f)(1)	Frequency Offset	2.2.24	572.000, 589.925, 607.875, 614.125, 615.875	A	Pass
15.236(f)(2)	Maximum Bandwidth	2.2.24	572.000, 589.925, 607.875, 614.125, 615.875	A	Pass
15.236(g)	Radiated Spurious Emissions	2.2.24	572.000, 589.925, 607.875, 614.125, 615.875	B	Pass
15.236(d)(1)	Maximum Rated Power	2.2.24	572.000, 589.925, 607.875, 614.125, 615.875	C	Pass
15.236(f)(3)	Frequency Tolerance	2.2.24	572.000, 589.925, 607.875, 614.125, 615.875	D	Pass
2.1015	Conducted Spurious Emissions	2.2.24	572.000, 589.925, 607.875, 614.125, 615.875	E	Pass

2 APPLICABLE DOCUMENTS

The following documents of the exact issue designated form part of this document to the extent specified herein:

FCC Part 15C, Section 15.236(g)

FCC Part 15C, Section 15.236(d)(1)

FCC Part 15C, Section 15.236(f)(1)

FCC Part 15C, Section 15.236(f)(2)

FCC Part 15C, Section 15.236(f)(3)

FCC Title 47, Chapter I, Subchapter A, Part 2 – Frequency Allocations and Radio Treaty Matters, General Rules and Regulations, Subpart J – Equipment Authorization Procedures

EN 300 422-1 V1.4.2 (2011-08), “Electromagnetic compatibility and Radio spectrum Matters (ERMM); Wireless Microphones in the 25 MHz to 3 GHz frequency range; Part 1: technical characteristics and methods of measurement”

ANSI C63.4 (2014), "American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz"

"Federal Communications Commission
Office of Engineering and Technology, Laboratory Division
BASIC CERTIFICATION REQUIREMENTS FOR WIRELESS MICROPOHONES"
Dated December 13, 2017

RSS-Gen Issue 5, "General Requirements for Compliance of Radio Apparatus"

RSS-210 Issue 9, "Licence-Exempt Radio Apparatus: Category I Equipment"

3 EUT SET-UP AND OPERATION

3.1. General Description

The test sample used was Shure ULXD1 digital wireless microphone transmitter. The EUT was arranged and tested per individual Appendices.

3.2 Test Sample

The following product sample was tested:

Table 3: Shure ULXD1 Digital Wireless Transmitter Sample

Band	Serial Numbers
J50A	J5x WMrev02 GC SAMPLE

3.3 Operational Mode

The transmit frequency and output power modes shown in the individual appendixes.

4. Test Instrumentation

A list of the test equipment used can be found in Table 10-1. All equipment used was within calibration during and throughout the duration of the tests. All calibrations are traceable to the National Institute of Standards and Technology (NIST).

5. Procedure

The specific test procedures are presented in the individual appendices.

6. Other Test Conditions:

6.1. Test Personnel

All EMC tests were performed by qualified personnel from the Shure EMC Laboratory.

6.2. Disposition of the EUT

The EUTs and all associated equipment were returned to Shure Incorporated upon completion of the tests.

7. Results of Tests:

The results are presented in Appendices. It was found that the EUT meets the requirements of FCC Part 15C, Section 236(g), Section 15.236(d)(1), Section 15.236(f)(1), Section 15.236(f)(2), Section 15.236(f)(3), the FCC OET Basic Certification Requirements for Wireless Microphones, FCC 2.1051, RSS-Gen, and.RSS-210

8. Conclusions:

It was determined that the Shure ULXD1 Digital Wireless Microphone Transmitter did fully comply with the requirements of FCC Part 15C, Section 236(g), Section 15.236(d)(1), Section 15.236(f)(1), Section 15.236(f)(2), Section 15.236(f)(3) and the FCC OET Basic Certification Requirements for Wireless Microphones, FCC 2.1051, RSS-Gen, RSS-210.

9. **Certification**:

Shure EMC Laboratory certifies that the information contained in this report was obtained under conditions which meet or exceed those specified in the test specifications.

The data presented in this test report pertains to the EUTs at the test date. Any electrical or mechanical modification made to the EUTs subsequent to the specified test date will serve to invalidate the data and void this certification.

This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.

10. Equipment List

Table 10-1 Test Equipment

L# or ID	Description	Manufacturer	Model #	Serial #	Frequency Range	Cal Date	Due Date
L23-011-01	3 meter RF Chamber	ETS Lindgren	FACT-3	AJ640	25MHz - 18GHz	8/8/2016	8/8/2019
L23-011-02	Electric Powered Turntable	ETS Lindgren	2088	N/A	N/A	N/A	N/A
L23-011-08	Controller	EMCO	2090	29799	N/A	N/A	N/A
L23-011-09	Antenna Positioner	ETS Lindgren	2071-2	35500	N/A	N/A	N/A
L23-011-15	BiConiLog Antenna	ETS Lindgren	3142C	34790	25MHz-1GHz	6/22/2017	6/22/2019
L23-011-54	EMI Test Receiver	Rohde & Schwarz	ESR26	100220	9kHz-26GHz	11/28/2017	11/28/2019
L23-011-31	EMI/EMS Test Software	Rohde & Schwarz	EMC32	V 9.21.00	N/A	N/A	N/A
L23-011-53	Horn antenna with pre-amplifier	ETS Lindgren	3117-PA	200363	1GHz to 18 GHz	10/16/2017	4/27/2019
L23-011-41	Horn Antenna	ETS Lindgren	3117	123511	1GHz to 18 GHz	5/7/2017	5/7/2019
L23-011-56	High Pass Filter	K&L	11SH10-940/X10000-0/0	2	940MHz – 10GHz	10/18/2017	3/31/2019
L23-022-02	Spectrum Analyzer	Rohde & Schwarz	FSW26	103788	9kHz-26GHz	4-24-2018	4-24-2020
L23-022-01	Spectrum Analyzer	Rohde & Schwarz	FSU26	201043	9kHz-26GHz	8/23/2017	8/23/2019
L23-034-02	Temperature Hygrometer	Extech	445703	48254-65	N/A	5/2/2018	5/2/2019
L23-034-04	Temperature Hygrometer	Extech	445703	48254-13	N/A	5/2/2018	5/2/2019
L23-040-03	20dB Attenuator	MCL	BW-N20W5+	N/A	20MHz to 18GHz	5/31/2018	5/31/2020
L23-045-36	RF Power Sensor	ETS-Lindgren	7002-006	151071	10MHz to 6GHz	1-31-2018	1-31-2020
L23-024-01	Frequency Counter	Agilent	53220A	MY50006485	DC to 6GHz	11-27-2018	11-27-2020
L23-034-08	Thermometer	Extech	TM100	13018733	N/A	4-25-2018	04-25-2020
L19-006-01	Temperature Chamber	ESPEC	SU-240	910004211	N/A	4-5-2018	4-5-2019
L23-023-01	RF Signal Generator	Rohde & Schwarz	SMF100A	101553	20Hz to 26.5GHz	8/23/2017	8/23/2019

Appendix A

NECESSARY BANDWIDTH
FREQUENCY OFFSET
OPERATING BANDWIDTH

PURPOSE

This test was performed to determine if the EUT meets the necessary bandwidth requirements of EN 300 422-1, section 8.3.2., and RSS-210 Annex G, with the EUT operating at 572.000MHz, 589.875MHz, 607.875, 614.125, and 615.875MHz.

This testing results show the EUT meets FCC 15C 15.236(f)(1), a frequency offset of the lower band limits by 25kHz or an integral multiple thereof. The frequency offset is 125 kHz.

The testing results show the EUT meets FCC 15C 15.236(f)(2) and RSS-210, operating bandwidth does not exceed 200kHz.

REQUIREMENTS

As stated in EN 300 422-1, section 8.3.2, the emission mask given in section 8.3.2.2 shall not be exceeded.

TEST SETUP AND INSTRUMENTATION

A photograph of the test setup is shown in Figure A-1. The test instrumentation can be determined from Table 10-1.

MEASUREMENT UNCERTAINTY

All measurements are an estimate of their true value. The measurement uncertainty characterizes, with a specified confidence level, the spread of values which may be possible for a given measurement system. Values of Expanded Measurement Uncertainty (95% Confidence):

Measurement Type	U_{LAB}
Necessary Bandwidth	**±0.130 %**

U_{lab} = Determined for Shure EMC Laboratory

Since U_{LAB} is less than or equal to U_{ETSI}:

- Compliance is deemed to occur if no measured disturbance exceeds the disturbance limit;
- Non-compliance is deemed to occur if any measured disturbance exceeds the disturbance limit.

EUT OPERATION

The EUT was powered up and the transmit frequency and power output of the EUT were selected. The EUT was checked for proper operation after it was setup for the test. Testing was conducted with the EUT set to transmit at 572.000MHz, 589.925MHz, 607.875, at an output power level of 1mW and 20mW, except 614.125 and 615.875 which will have the power level of 1mW and 10mW. The transmitter was modulated per EN300422-1 V1.4.2 (2011-08), clause 7.1.2.

Appendix A

TEST PROCEDURE

The test procedure followed is shown in EN300422-1 V1.4.2 (2011-08), section 8.3.2.

RESULTS

The necessary bandwidth data is presented on pages 12 and 26. Data is shown on the figures for each transmitter. The figure shows the maximum relative level within the emission mask with modulation. As shown by the test data, the necessary bandwidth of the EUT meets the requirements of EN 300 422-1, section 8.3.2. The RSS-Gen maximum ISED Canada 99% bandwidth measurement was 163 kHz.

The temperature during the testing was 74 degrees F, with relative humidity of 17%.

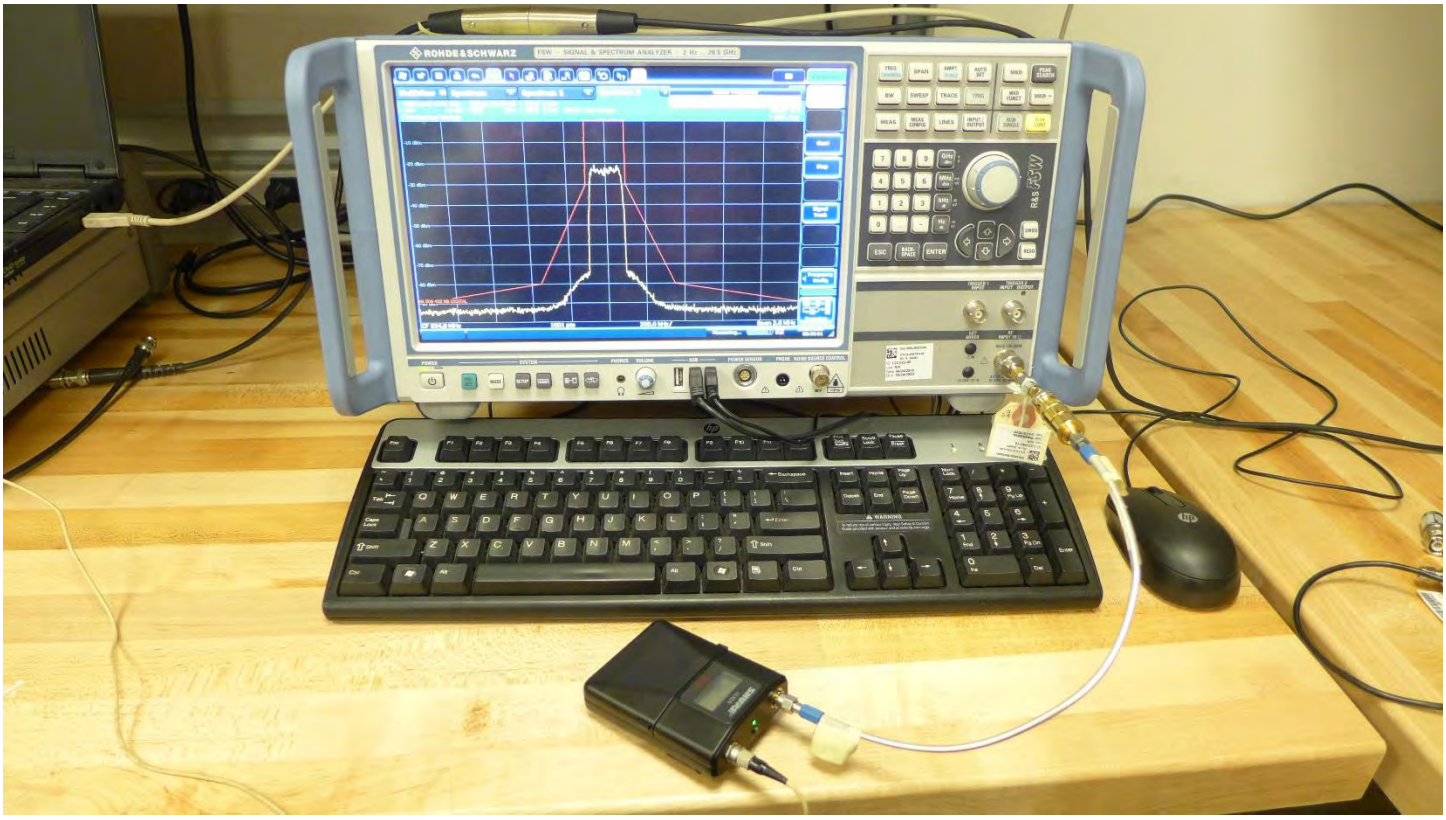
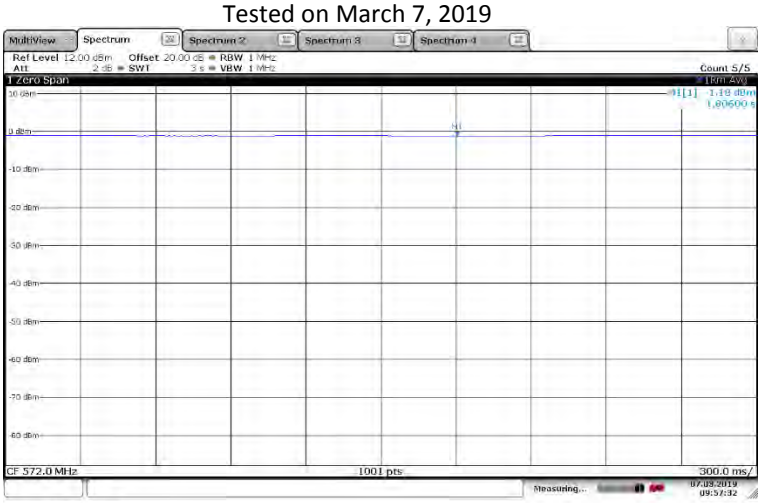


Figure A-1 - Test Setup for Necessary Bandwidth

Appendix A

Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	EN 300 422 Digital Necessary Bandwidth
Operating Conditions:	Low Band, Low Frequency, 572.000MHz, 1mW
Operator Name:	Craig Kozokar
Comment:	8.3.2.1: Step 1; Carrier Power
Date Tested:	Tested on March 7, 2019



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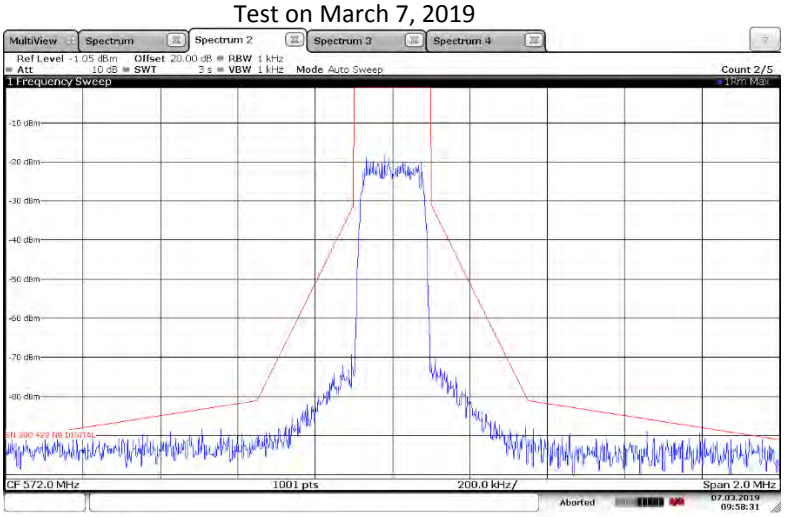
Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	EN 300 422 Digital Necessary Bandwidth
Operating Conditions:	Low Band, Low Frequency, 572.000MHz, 1mW
Operator Name:	Craig Kozokar
Comment:	8.3.2.1: Step 2;Maximum Relative Level
Date Tested:	Test on March 7, 2019



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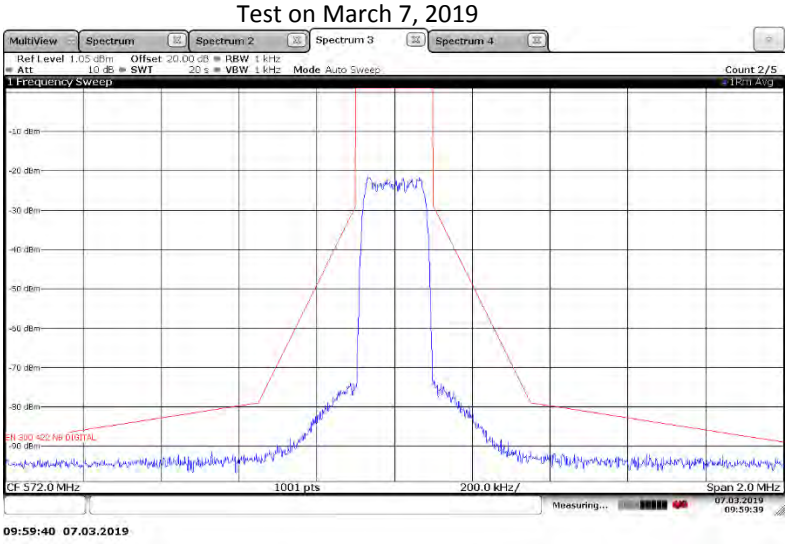
Appendix A

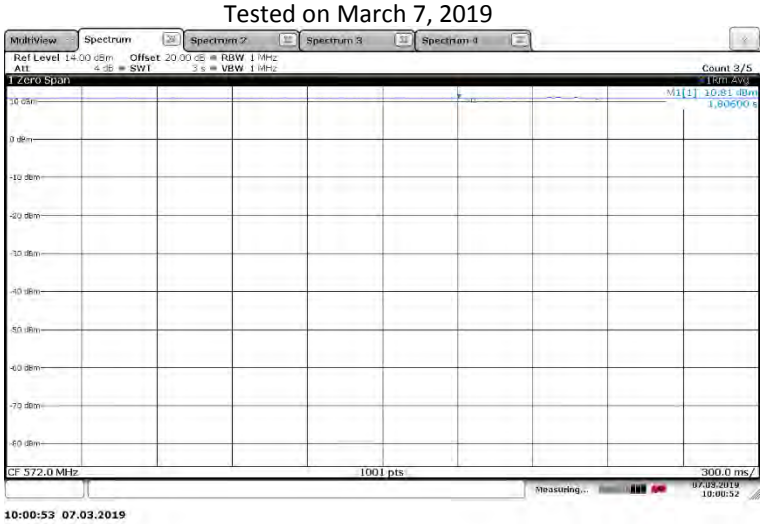
Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	EN 300 422 Digital Necessary Bandwidth
Operating Conditions:	Low Band, Low Frequency, 572.000MHz, 1mW
Operator Name:	Craig Kozokar
Comment:	8.3.2.1: Step 3;Lower and upper frequency transmitter band Wide band noise floor
Date Tested:	Test on March 7, 2019



Test Information

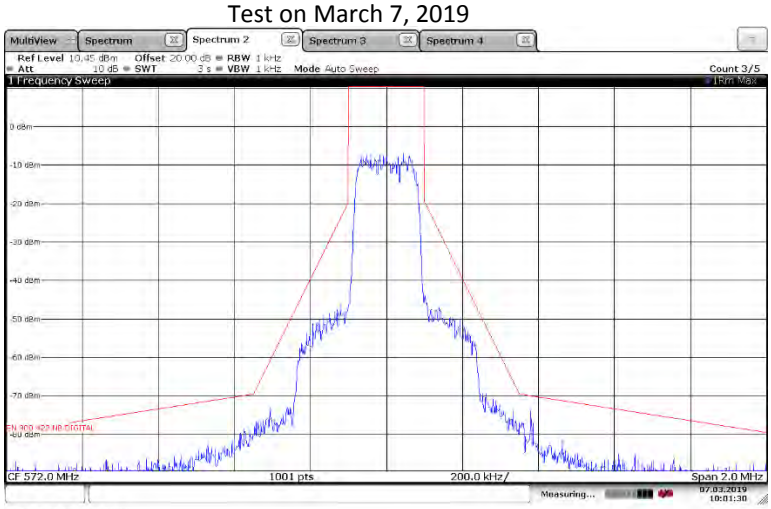
EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	EN 300 422 Digital Necessary Bandwidth
Operating Conditions:	Low Band, Low Frequency, 572.000MHz, 20mW
Operator Name:	Craig Kozokar
Comment:	8.3.2.1: Step 1; Carrier Power
Date Tested:	Tested on March 7, 2019



Appendix A

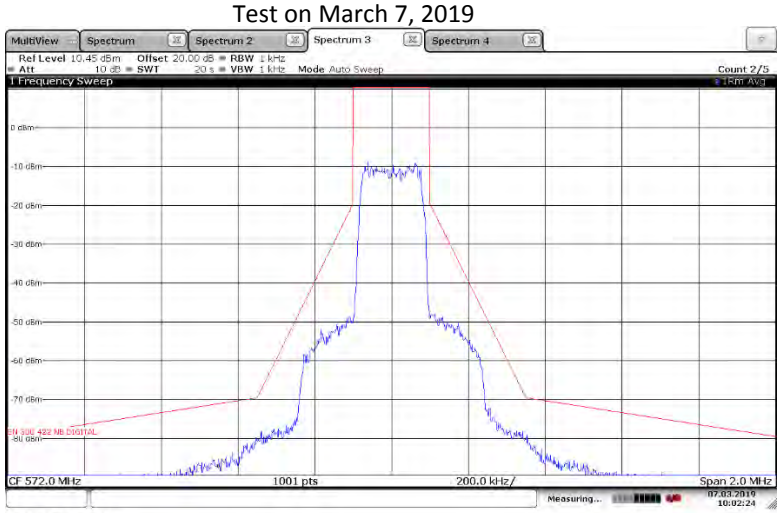
Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	EN 300 422 Digital Necessary Bandwidth
Operating Conditions:	Low Band, Low Frequency, 572.000MHz, 20mW
Operator Name:	Craig Kozokar
Comment:	8.3.2.1: Step 2;Maximum Relative Level
Date Tested:	Test on March 7, 2019



Test Information

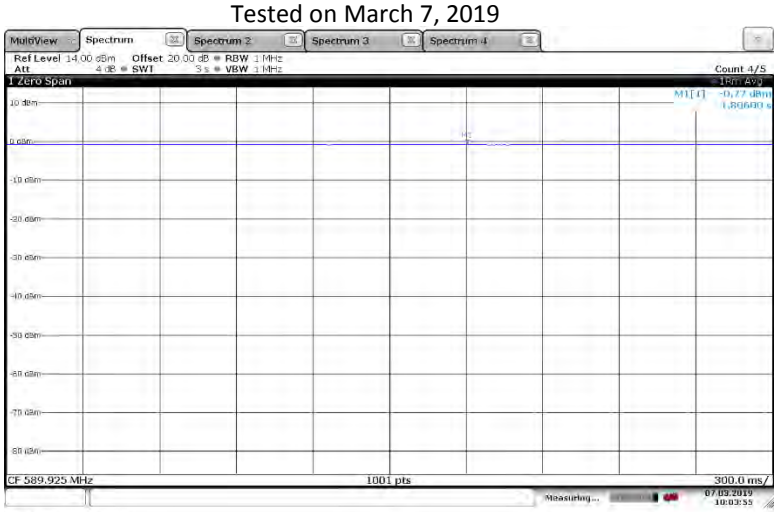
EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	EN 300 422 Digital Necessary Bandwidth
Operating Conditions:	Low Band, Low Frequency, 572.000MHz, 20mW
Operator Name:	Craig Kozokar
Comment:	8.3.2.1: Step 3;Lower and upper frequency transmitter band Wide band noise floor
Date Tested:	Test on March 7, 2019



Appendix A

Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	EN 300 422 Digital Necessary Bandwidth
Operating Conditions:	Low Band, Middle Frequency, 589.925MHz, 1mW
Operator Name:	Craig Kozokar
Comment:	8.3.2.1: Step 1; Carrier Power
Date Tested:	Tested on March 7, 2019



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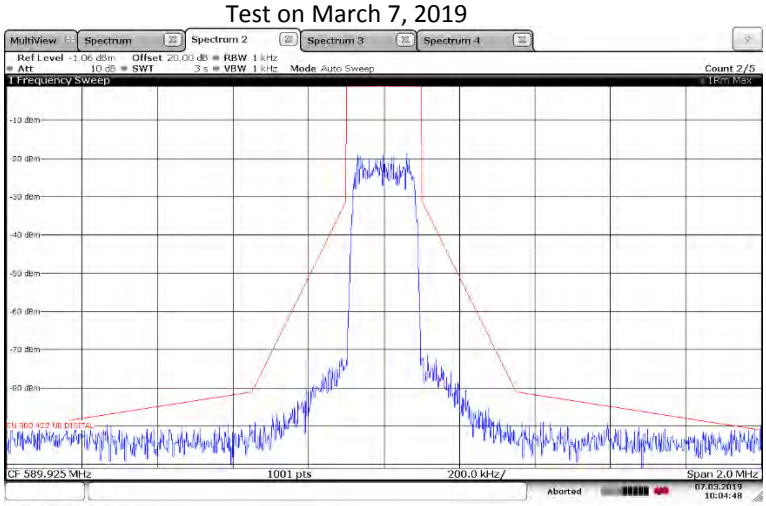
Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	EN 300 422 Digital Necessary Bandwidth
Operating Conditions:	Low Band, Middle Frequency, 589.925MHz, 1mW
Operator Name:	Craig Kozokar
Comment:	8.3.2.1: Step 2;Maximum Relative Level
Date Tested:	Test on March 7, 2019



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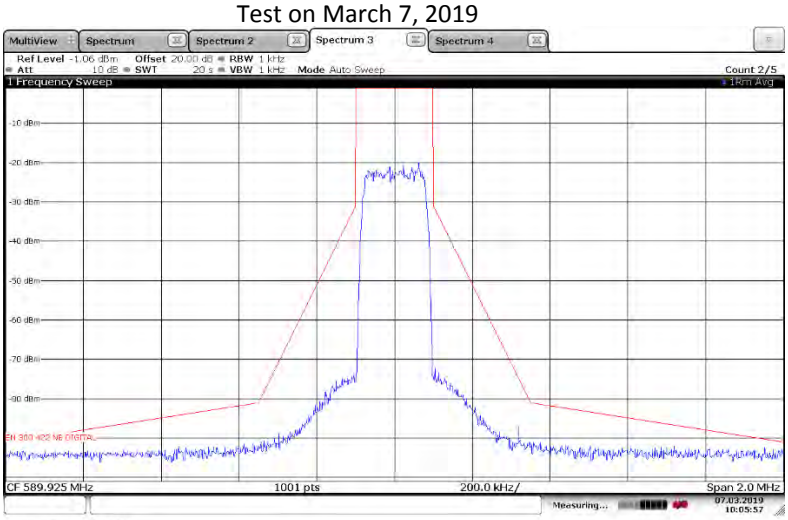
Appendix A

Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	EN 300 422 Digital Necessary Bandwidth
Operating Conditions:	Low Band, Middle Frequency, 589.925MHz, 1mW
Operator Name:	Craig Kozokar
Comment:	8.3.2.1: Step 3;Lower and upper frequency transmitter band Wide band noise floor
Date Tested:	Test on March 7, 2019



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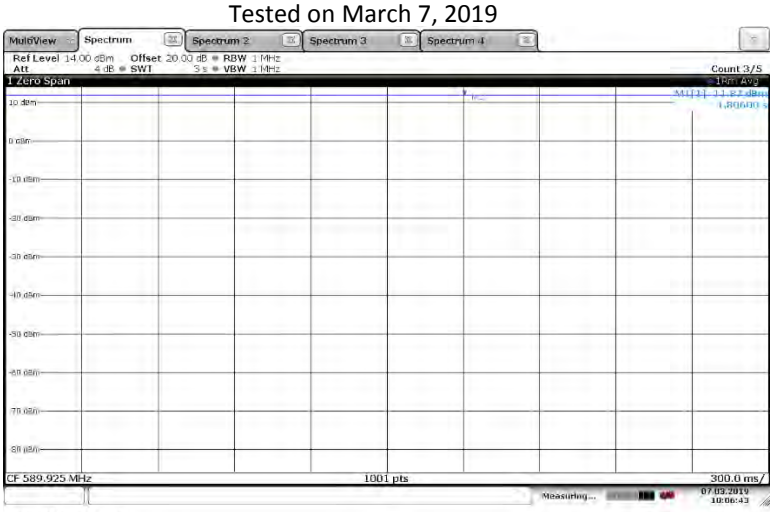
Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	EN 300 422 Digital Necessary Bandwidth
Operating Conditions:	Low Band, Middle Frequency, 589.925MHz, 20mW
Operator Name:	Craig Kozokar
Comment:	8.3.2.1: Step 1; Carrier Power
Date Tested:	Tested on March 7, 2019



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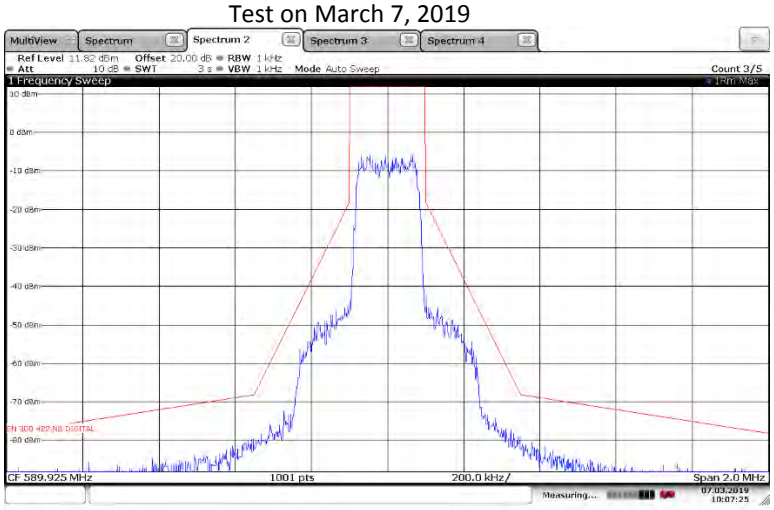
Appendix A

Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	EN 300 422 Digital Necessary Bandwidth
Operating Conditions:	Low Band, Middle Frequency, 589.925MHz, 20mW
Operator Name:	Craig Kozokar
Comment:	8.3.2.1: Step 2;Maximum Relative Level
Date Tested:	Test on March 7, 2019



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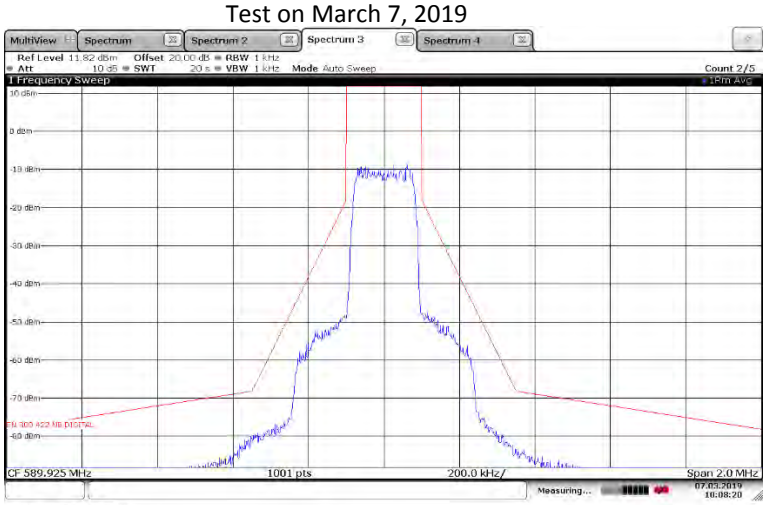
Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	EN 300 422 Digital Necessary Bandwidth
Operating Conditions:	Low Band, Middle Frequency, 589.925MHz, 20mW
Operator Name:	Craig Kozokar
Comment:	8.3.2.1: Step 3;Lower and upper frequency transmitter band Wide band noise floor
Date Tested:	Test on March 7, 2019



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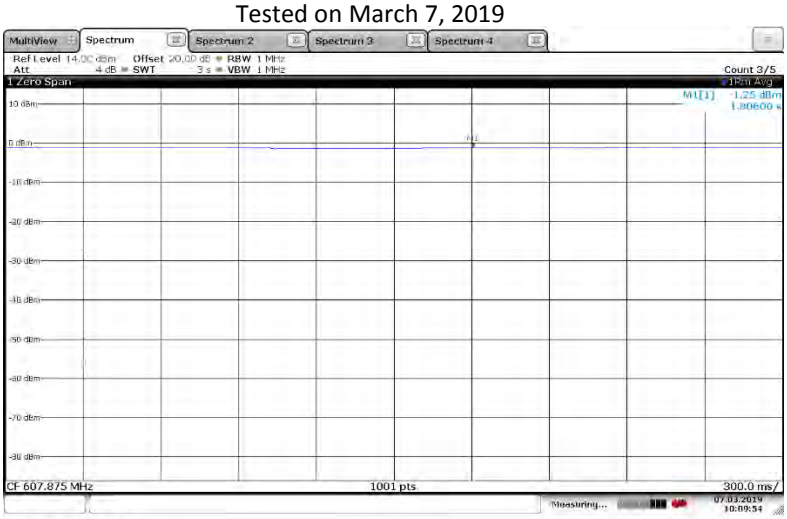
Appendix A

Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	EN 300 422 Digital Necessary Bandwidth
Operating Conditions:	Low Band, High Frequency, 607.875MHz, 1mW
Operator Name:	Craig Kozokar
Comment:	8.3.2.1: Step 1; Carrier Power
Date Tested:	Tested on March 7, 2019



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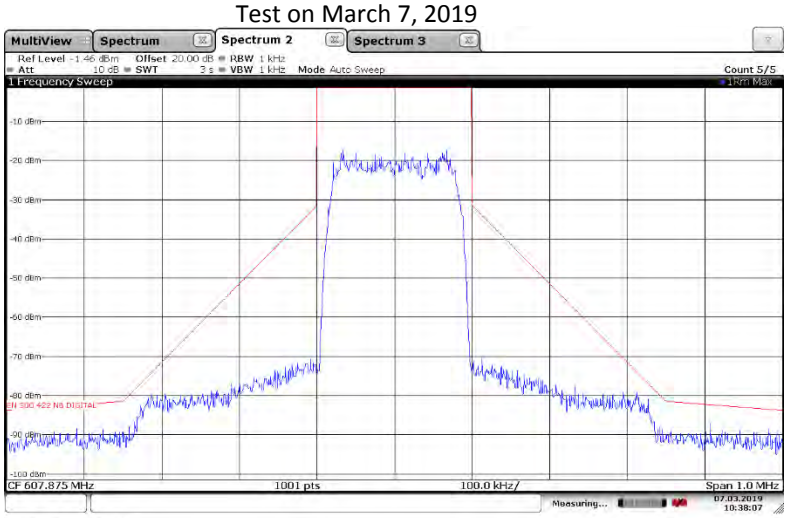
Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	EN 300 422 Digital Necessary Bandwidth
Operating Conditions:	Low Band, High Frequency, 607.875MHz, 1mW
Operator Name:	Craig Kozokar
Comment:	8.3.2.1: Step 2;Maximum Relative Level
Date Tested:	Test on March 7, 2019



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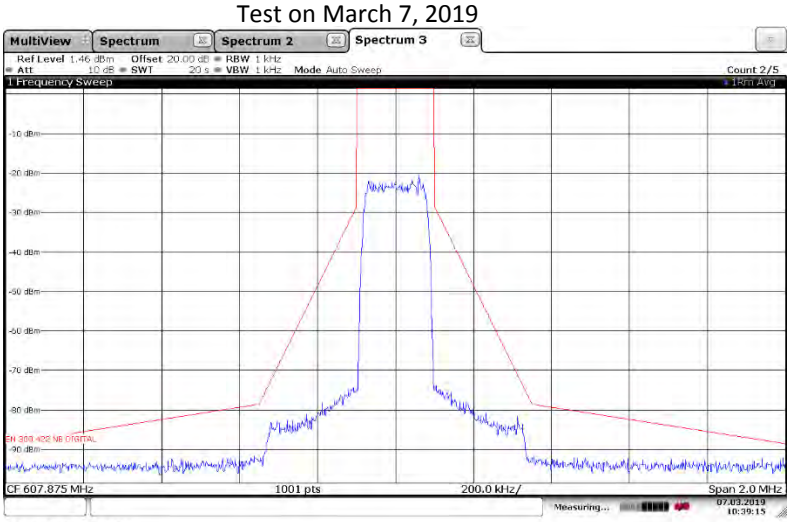
Appendix A

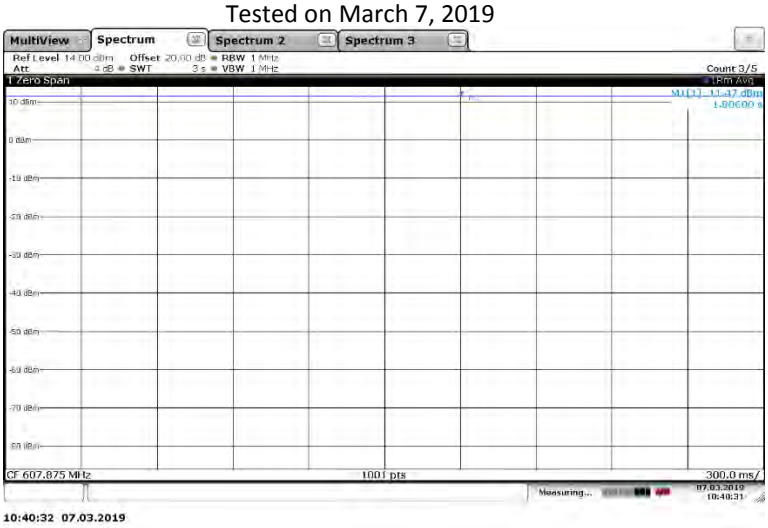
Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	EN 300 422 Digital Necessary Bandwidth
Operating Conditions:	Low Band, High Frequency, 607.875MHz, 1mW
Operator Name:	Craig Kozokar
Comment:	8.3.2.1: Step 3;Lower and upper frequency transmitter band Wide band noise floor
Date Tested:	Test on March 7, 2019



Test Information

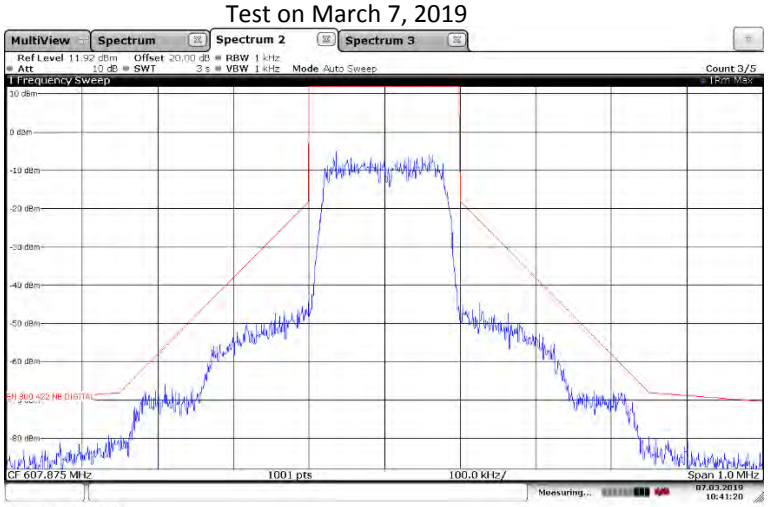
EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	EN 300 422 Digital Necessary Bandwidth
Operating Conditions:	Low Band, High Frequency, 607.875MHz, 20mW
Operator Name:	Craig Kozokar
Comment:	8.3.2.1: Step 1; Carrier Power
Date Tested:	Tested on March 7, 2019



Appendix A

Test Information

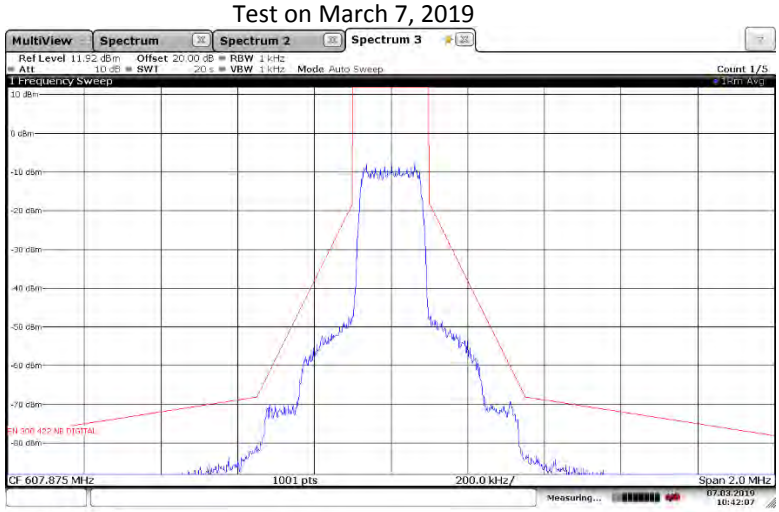
EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	EN 300 422 Digital Necessary Bandwidth
Operating Conditions:	Low Band, High Frequency, 607.875MHz, 20mW
Operator Name:	Craig Kozokar
Comment:	8.3.2.1: Step 2;Maximum Relative Level
Date Tested:	Test on March 7, 2019



10:41:21 07.03.2019

Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	EN 300 422 Digital Necessary Bandwidth
Operating Conditions:	Low Band, High Frequency, 607.875MHz, 20mW
Operator Name:	Craig Kozokar
Comment:	8.3.2.1: Step 3;Lower and upper frequency transmitter band Wide band noise floor
Date Tested:	Test on March 7, 2019

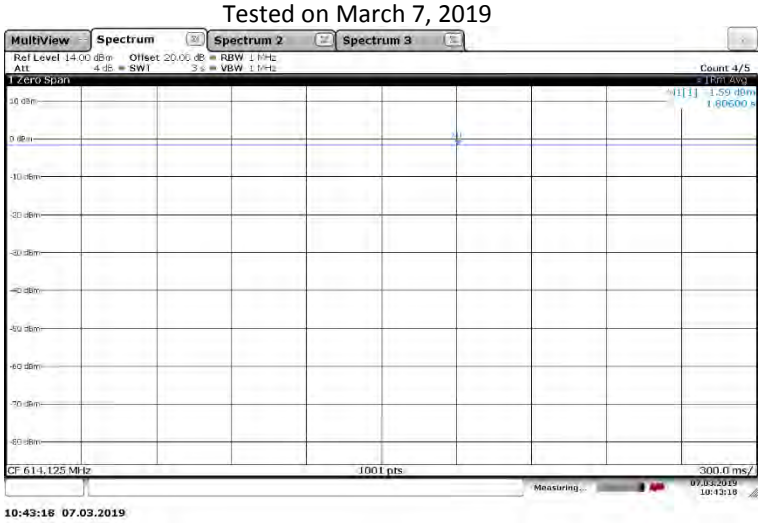


10:42:07 07.03.2019

Appendix A

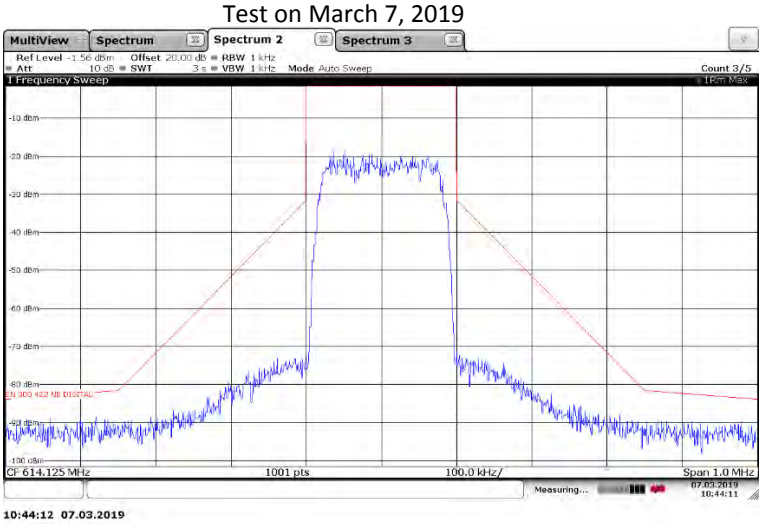
Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	EN 300 422 Digital Necessary Bandwidth
Operating Conditions:	High Band, Low Frequency, 614.125MHz, 1mW
Operator Name:	Craig Kozokar
Comment:	8.3.2.1: Step 1; Carrier Power
Date Tested:	Tested on March 7, 2019



Test Information

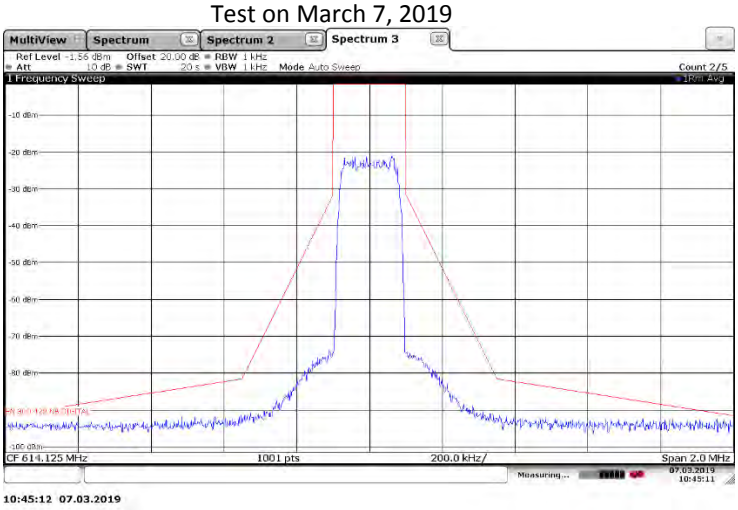
EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	EN 300 422 Digital Necessary Bandwidth
Operating Conditions:	High Band, Low Frequency, 614.125MHz, 1mW
Operator Name:	Craig Kozokar
Comment:	8.3.2.1: Step 2;Maximum Relative Level
Date Tested:	Test on March 7, 2019



Appendix A

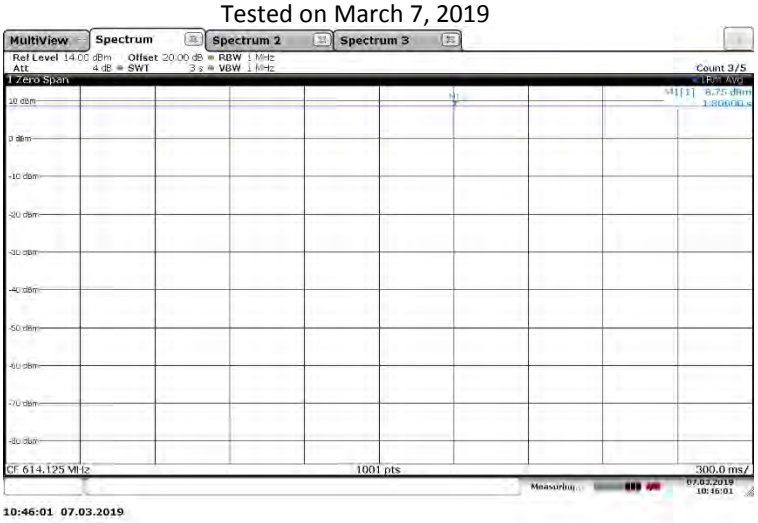
Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	EN 300 422 Digital Necessary Bandwidth
Operating Conditions:	High Band, Low Frequency, 614.125MHz, 1mW
Operator Name:	Craig Kozokar
Comment:	8.3.2.1: Step 3;Lower and upper frequency transmitter band Wide band noise floor
Date Tested:	Test on March 7, 2019



Test Information

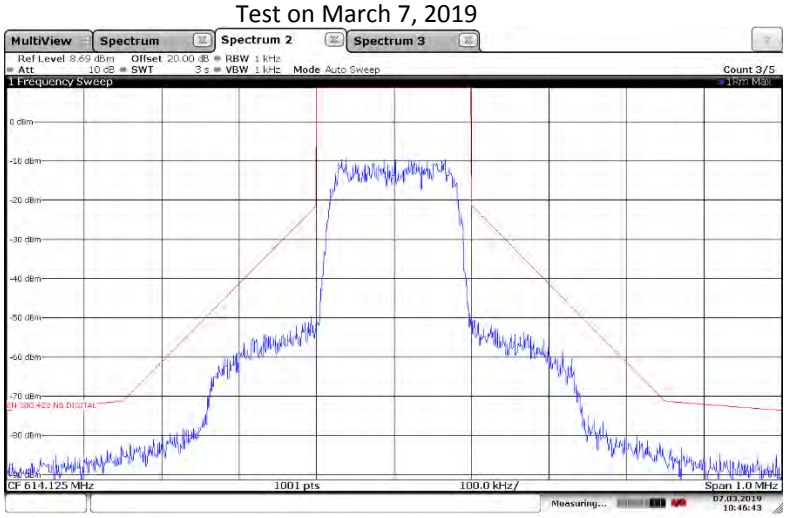
EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	EN 300 422 Digital Necessary Bandwidth
Operating Conditions:	High Band, Low Frequency, 614.125MHz, 10mW
Operator Name:	Craig Kozokar
Comment:	8.3.2.1: Step 1; Carrier Power
Date Tested:	Tested on March 7, 2019



Appendix A

Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	EN 300 422 Digital Necessary Bandwidth
Operating Conditions:	High Band, Low Frequency, 614.125MHz, 10mW
Operator Name:	Craig Kozokar
Comment:	8.3.2.1: Step 2;Maximum Relative Level
Date Tested:	Test on March 7, 2019



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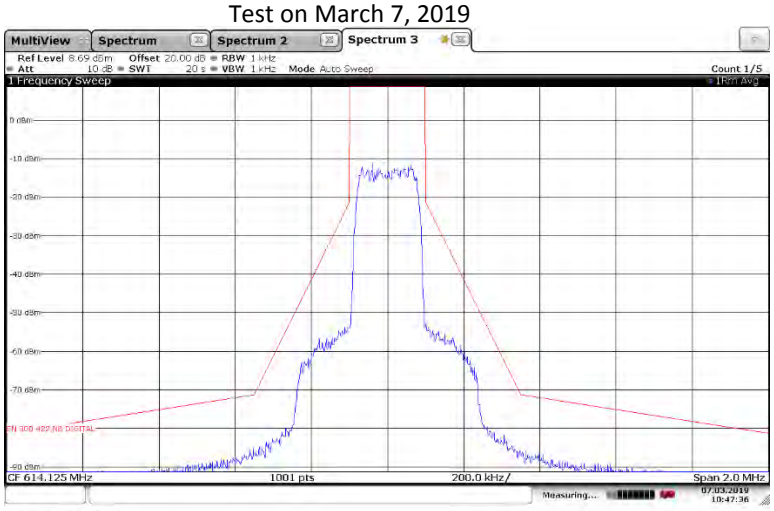
Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	EN 300 422 Digital Necessary Bandwidth
Operating Conditions:	High Band, Low Frequency, 614.125MHz, 10mW
Operator Name:	Craig Kozokar
Comment:	8.3.2.1: Step 3;Lower and upper frequency transmitter band Wide band noise floor
Date Tested:	Test on March 7, 2019

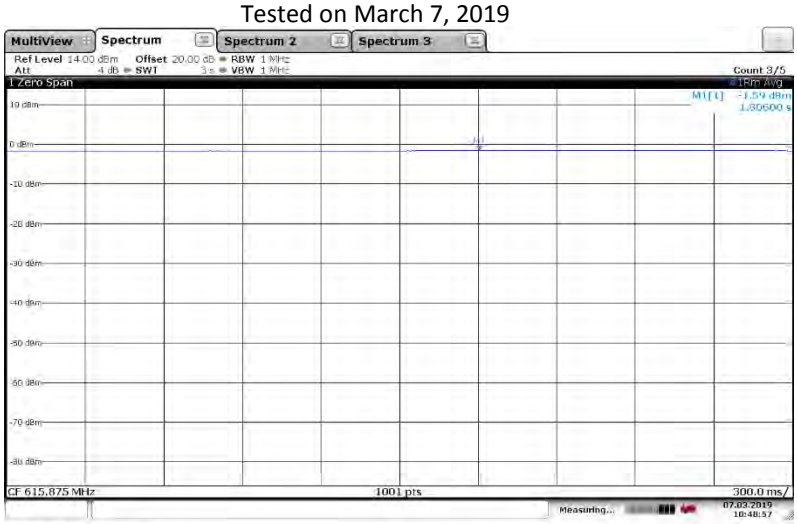


10:47:37 07.03.2019

Appendix A

Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	EN 300 422 Digital Necessary Bandwidth
Operating Conditions:	High Band, High Frequency, 615.875MHz, 1mW
Operator Name:	Craig Kozokar
Comment:	8.3.2.1: Step 1; Carrier Power
Date Tested:	Tested on March 7, 2019



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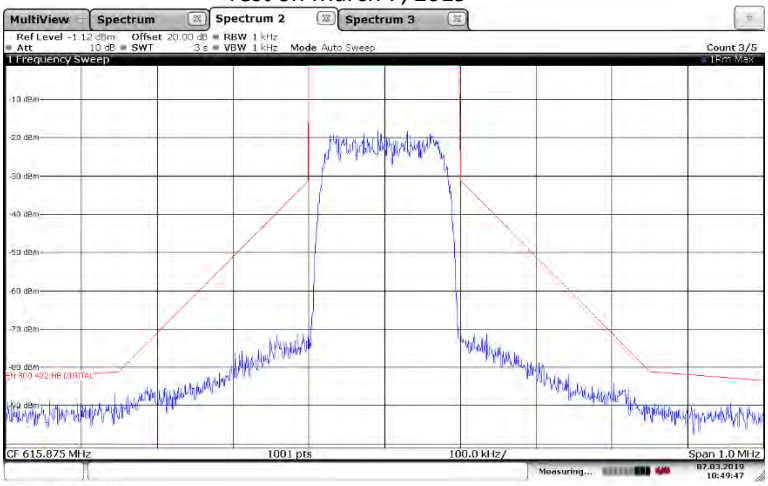
Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	EN 300 422 Digital Necessary Bandwidth
Operating Conditions:	High Band, High Frequency, 615.875MHz, 1mW
Operator Name:	Craig Kozokar
Comment:	8.3.2.1: Step 2;Maximum Relative Level
Date Tested:	Test on March 7, 2019

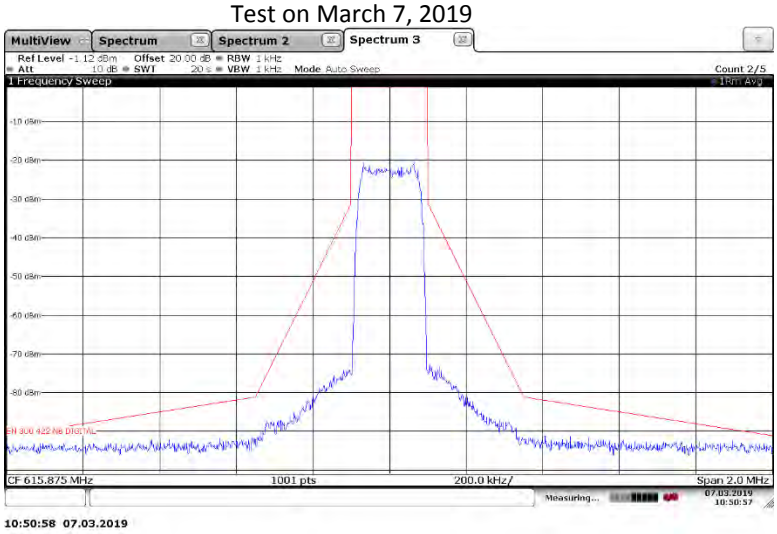


10:49:48 07.03.2019

Appendix A

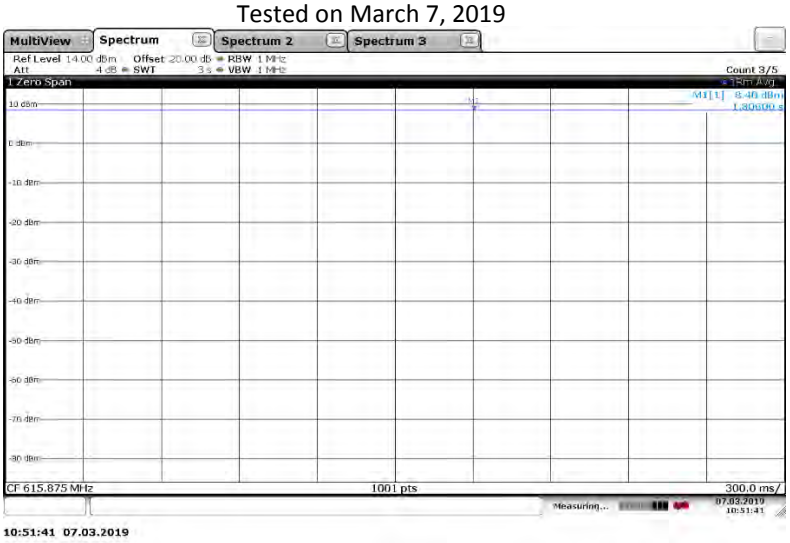
Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	EN 300 422 Digital Necessary Bandwidth
Operating Conditions:	High Band, High Frequency, 615.875MHz, 1mW
Operator Name:	Craig Kozokar
Comment:	8.3.2.1: Step 3;Lower and upper frequency transmitter band Wide band noise floor
Date Tested:	Test on March 7, 2019



Test Information

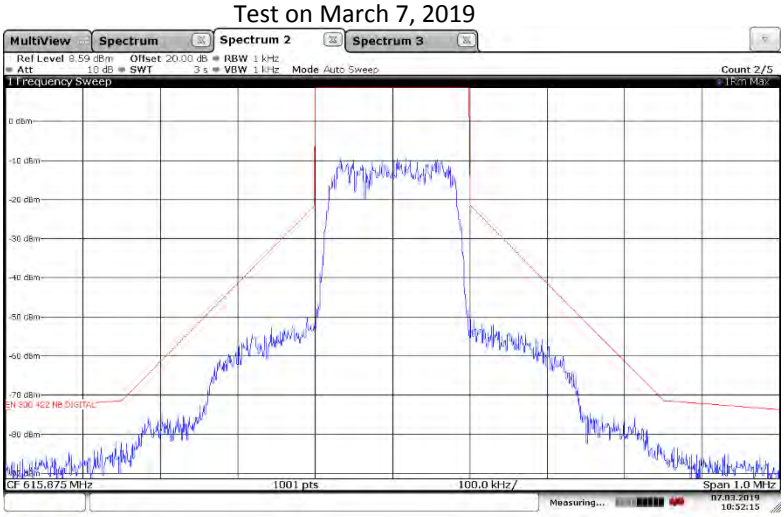
EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	EN 300 422 Digital Necessary Bandwidth
Operating Conditions:	High Band, High Frequency, 615.875MHz, 10mW
Operator Name:	Craig Kozokar
Comment:	8.3.2.1: Step 1; Carrier Power
Date Tested:	Tested on March 7, 2019



Appendix A

Test Information

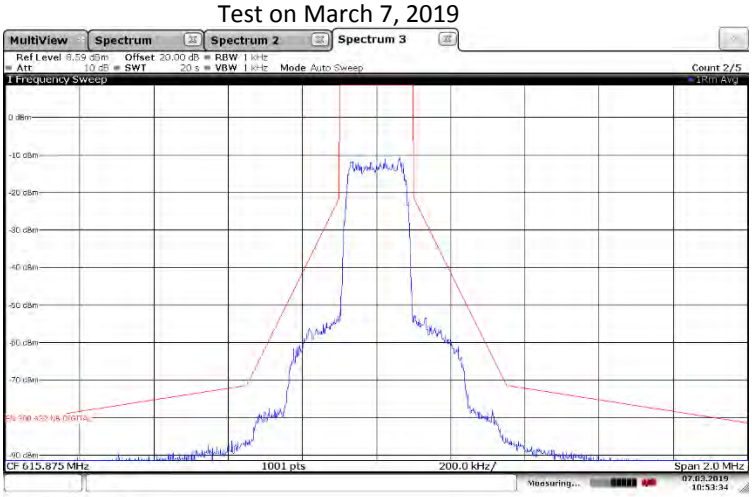
EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	EN 300 422 Digital Necessary Bandwidth
Operating Conditions:	High Band, High Frequency, 615.875MHz, 10mW
Operator Name:	Craig Kozokar
Comment:	8.3.2.1: Step 2;Maximum Relative Level
Date Tested:	Test on March 7, 2019



10:52:15 07.03.2019

Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	EN 300 422 Digital Necessary Bandwidth
Operating Conditions:	High Band, High Frequency, 615.875MHz, 10mW
Operator Name:	Craig Kozokar
Comment:	8.3.2.1: Step 3;Lower and upper frequency transmitter band Wide band noise floor
Date Tested:	Test on March 7, 2019



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Appendix B

Radiated Spurious Emissions

Purpose:

This test performed to determine if the EUT meets the radiated RF emission requirements of the FCC Part 15C section 236(g) and FCC OET Basic Certification Requirements for Wireless Microphones over the frequency range from 30MHz to 7GHz. A Quasi-Peak and Average detectors were used for the measurements. Both FCC Part 15C and IC RSS-Gen require measurements to the 10th harmonic of the carrier.

Requirements:

As stated in FCC 15C section 236(g), the FCC OET Basic Certification Requirements for Wireless Microphones, and RSS-210 Annex G, Compliance for spurious emission requirements shall be demonstrated using the applicable measurement procedures of ETSI EN 300 422-1. Compliance with the emission limits shall be demonstrated using a QP detector below 1GHz and a RMS Average detector above 1GHz. Emissions shall be investigated up to the 10th harmonic of the fundamental.

Measurement Uncertainty:

All measurements are an estimate of their true value. The measurement uncertainty characterizes, with a specified confidence level, the spread of values which may be possible for a given measurement system.

Values of Expanded Measurement Uncertainty (95% Confidence)

Measurement Type	U_{lab}	U_{ETSI}
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1000 MHz)	4.24 dB	6.00 dB
Radiated disturbance (electric field strength on an open area test site or alternative test site) (1 GHz – 13 GHz)	4.56 dB	6.00 dB

U_{lab} = Determined for Shure EMC Laboratory

U_{ETSI} = From ETSI EN 300 422-1 Table 10

Since U_{lab} is less than or equal to U_{ETSI}:

- Compliance is deemed to occur if no measured disturbance exceeds the disturbance limit; Non-compliance is deemed to occur if any measured disturbance exceeds the disturbance limit.

Test Setup and Instrumentation:

A Shure TQG Microphone was plugged into the EUT microphone socket. Photographs of the test setup are shown in Figure B 1 and Figure B 2. The test instrumentation can be determined from Table 10-1.

EUT Operation:

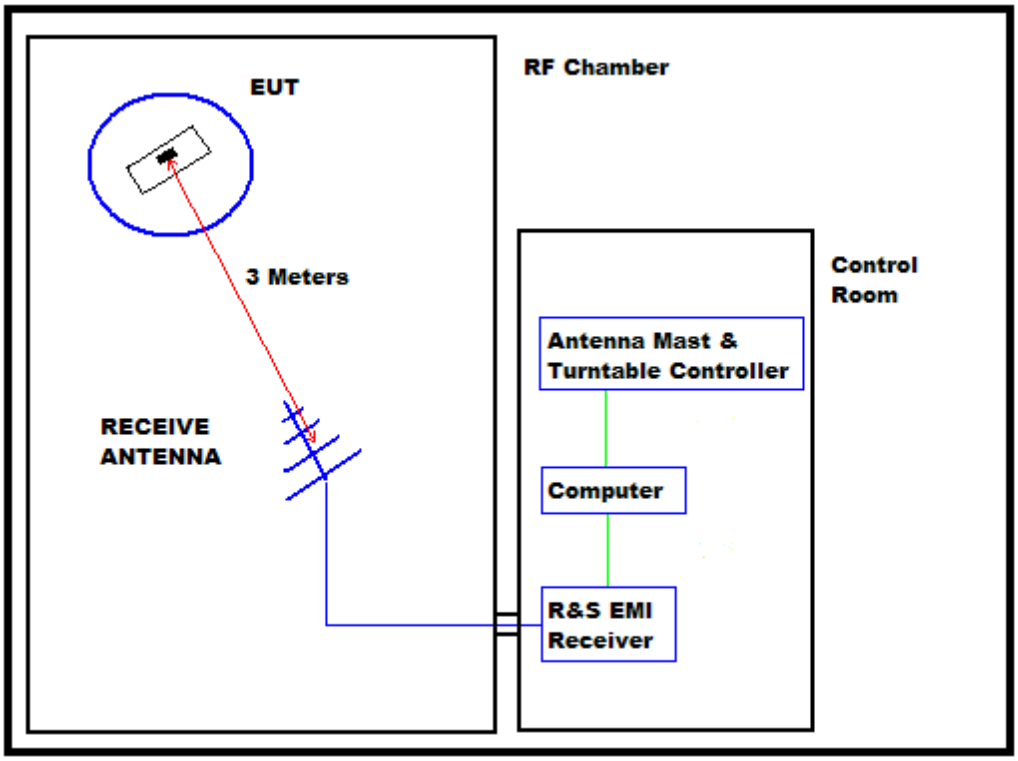
The EUT was powered up and the frequency of the transmitter was selected using the front panel controls. The EUT was checked for proper operation after it was setup on the test table. For radiated spurious emissions the testing was performed with the EUT set to the Low Band, 572.000, 589.925, 607.875, with RF power output of 1mW and 20mW, and the High Band, 614.125 and 615.875, with RF power output of 1mW and 10mW.

Appendix B

Specific Test Procedures:

All tests were performed in a 28ft. x 20ft. x 18.5ft. 3m semi-anechoic test chamber. The walls and ceiling of the shielded chamber are lined with ferrite tiles. Anechoic absorber material is installed over the ferrite tile. The floor of the chamber is used as the ground plane. The chamber complies with ANSI C63.4-2003 for site attenuation.

The shielded enclosure prevents emissions from other sources, such as radio and TV stations from interfering with the measurements. All power lines and signal lines entering the enclosure pass through filters on the enclosure wall. The power line filters prevent extraneous signals from entering the enclosure on these leads.



BLOCK DIAGRAM OF SHIELDED ENCLOSURE

Preliminary radiated measurements were performed to determine the frequencies where the significant emissions might be found. With the EUT at one set position and the measurement antenna at a set height (i.e. without maximizing), the radiated emissions were measured using a peak detector and automatically plotted. The BiConiLog measuring antenna was positioned at a 3 meter distance from the EUT for below 1GHz testing, and a double ridged waveguide antenna above 1GHz testing.

Appendix B

All significant broadband and narrowband signals found in the preliminary sweeps were then measured using a peak detector at a test distance of 3 meters. The measurements were made with a BiConiLog antenna over the frequency range of 30 MHz to 1 GHz, and a double ridged waveguide antenna over the frequency range of 1 GHz to 10 GHz.

To ensure that maximum emission levels were measured, the following steps were taken:

i. The EUT was rotated so that all of its sides were exposed to the receiving antenna.
ii. Since the measuring antennas are linearly polarized, both horizontal and vertical field components were measured.
iii. The measuring antenna was raised and lowered from 1 to 4 meters for each antenna polarization to maximize the readings.

The equivalent power was determined from the field intensity levels measured at 3 meters using the substitution method. To determine the emission power, another antenna was set in place of the EUT and connected to a calibrated signal generator. (A tuned dipole was used for all measurements below 1GHz and a double ridged waveguide antenna was used for all measurements above 1GHz.) The output of the signal generator was adjusted to match the received level at the EMI receiver. The signal level was recorded. The reading was corrected to compensate for cable loss and antenna gain.

Results:

The plots of the peak preliminary radiated voltage levels in the graphs on page 30 thru page 39. The ERP measurements are shown on pages 40 thru page 44. All emissions measured from the EUT were within the ETSI EN 300 422-1 specification limits.

The temperature during the testing in the RF Chamber was 73 degrees F, with relative humidity of 17%.

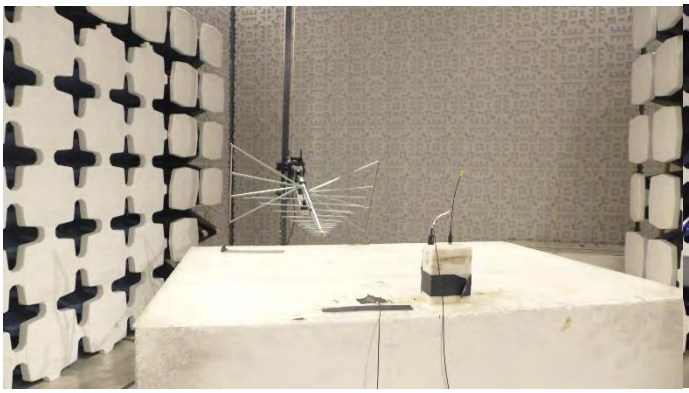


Figure B 1: ULXD1 Transmitter Test Setup

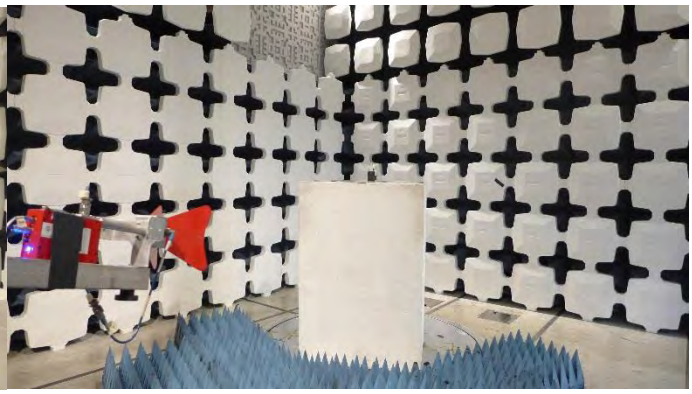


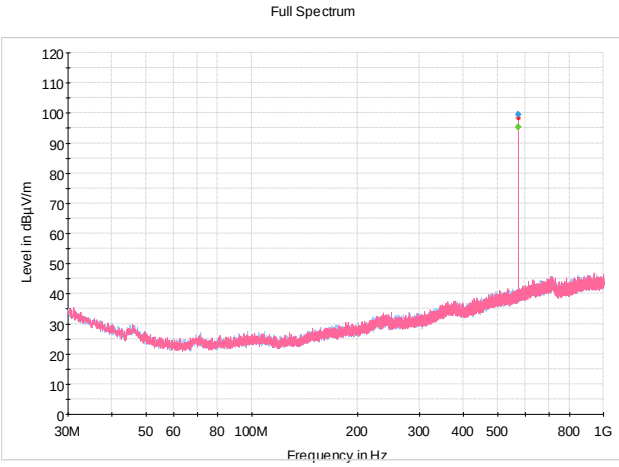
Figure B 2: ULXD1 Transmitter Test Setup

Appendix B

SHURE Radiated RF Emissions Test Report

Common Information

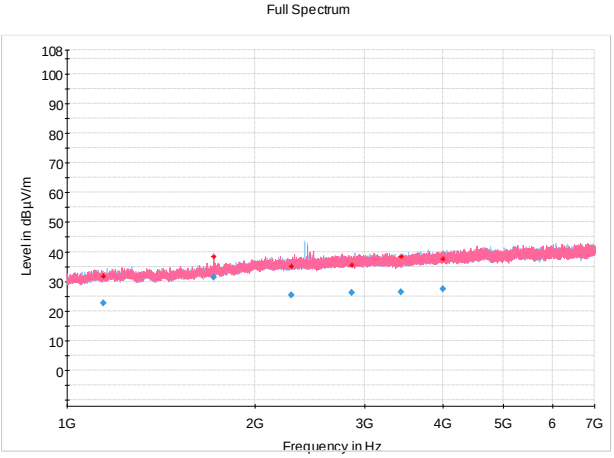
Test Description:	FCC 15C Radiated Emissions 30MHz - 1GHz
EUT:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Operating Frequency:	Low Band, Low Frequency, 572.000MHz
RF Power Level	1mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on February 27, 2019



SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 1GHz - 7GHz
EUT:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Operating Frequency:	Low Band, Low Frequency, 572.000MHz
RF Power Level	1mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on March 1, 2019

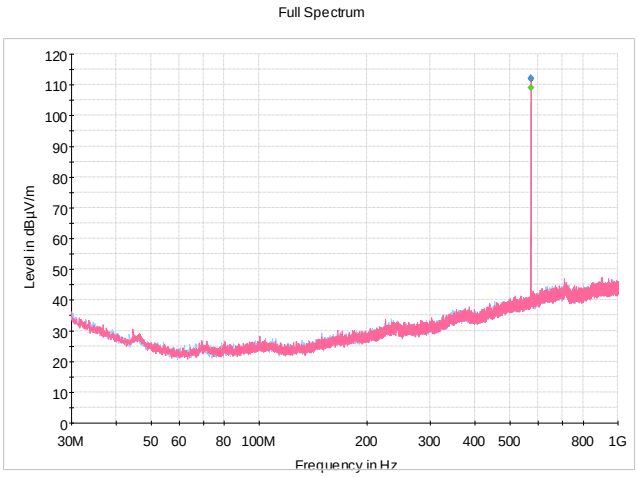


Appendix B

SHURE Radiated RF Emissions Test Report

Common Information

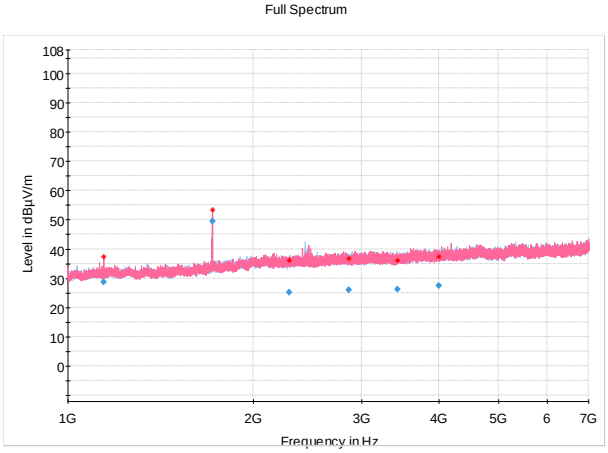
Test Description:	FCC 15C Radiated Emissions 30MHz - 1GHz
EUT:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Operating Frequency:	Low Band, Low Frequency, 572.000MHz
RF Power Level	20mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on February 27, 2019



SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 1GHz - 7GHz
EUT:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Operating Frequency:	Low Band, Low Frequency, 572.000MHz
RF Power Level	20mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on March 4, 2019

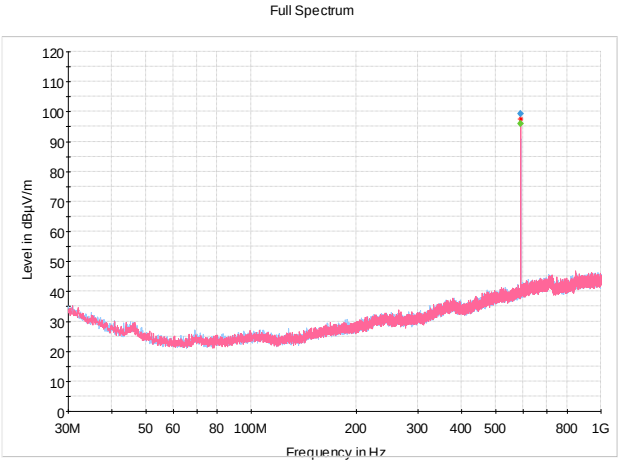


Appendix B

SHURE Radiated RF Emissions Test Report

Common Information

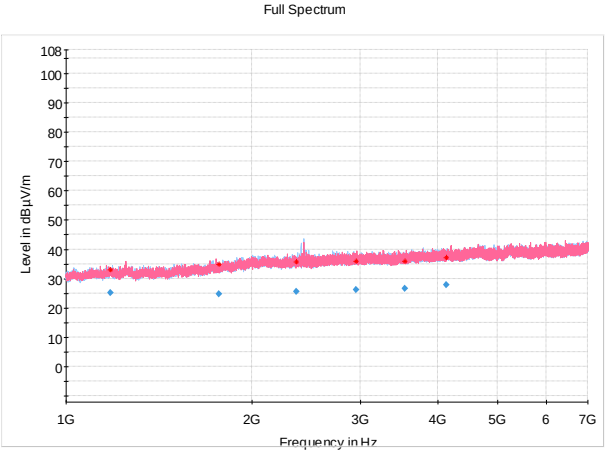
Test Description:	FCC 15C Radiated Emissions 30MHz - 1GHz
EUT:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Operating Frequency:	Low Band, Middle Frequency, 589.925MHz
RF Power Level	1mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on February 27, 2019



SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 1GHz - 7GHz
EUT:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Operating Frequency:	Low Band, Middle Frequency, 589.925MHz
RF Power Level	1mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on March 4, 2019

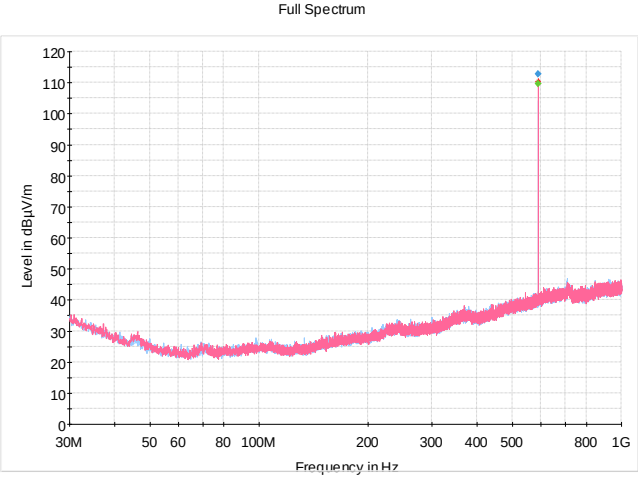


Appendix B

SHURE Radiated RF Emissions Test Report

Common Information

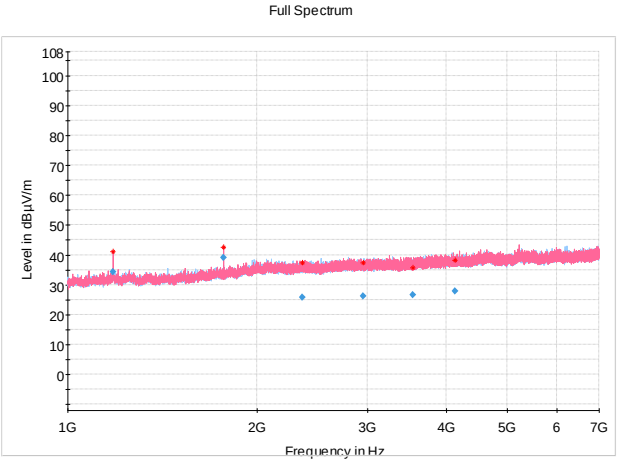
Test Description:	FCC 15C Radiated Emissions 30MHz - 1GHz
EUT	ULXD1 J50A
Serial Number	J5x WMrev02 GC SAMPLE
Operating Frequency:	Low Band, Middle Frequency, 589.925MHz
RF Power Level	20mW
Tester Name	Jamal Qureshi
Date Tested	Tested on February 27, 2019



SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 1GHz - 7GHz
EUT:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Operating Frequency:	Low Band, Middle Frequency, 589.925MHz
RF Power Level	20mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on March 4, 2019

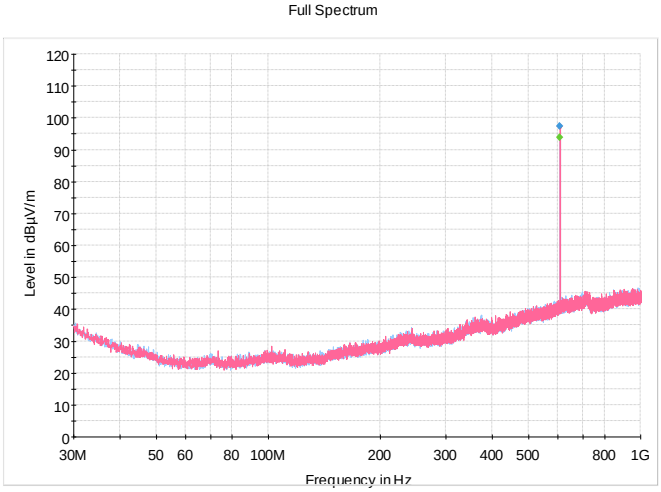


Appendix B

SHURE Radiated RF Emissions Test Report

Common Information

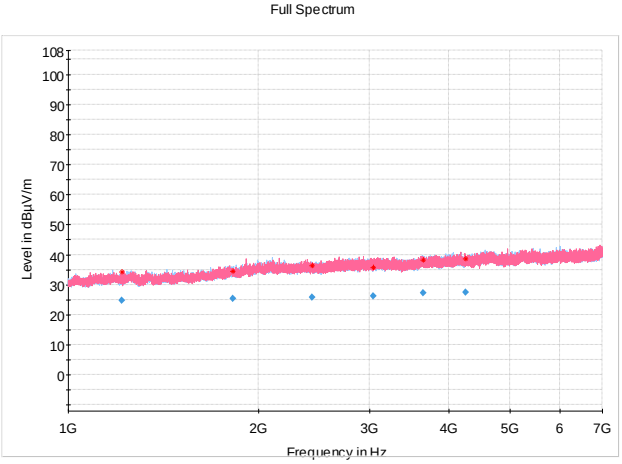
Test Description:	FCC 15C Radiated Emissions 30MHz - 1GHz
EUT	ULXD1 J50A
Serial Number	J5x WMrev02 GC SAMPLE
Operating Frequency:	Low Band, High Frequency, 607.875MHz
RF Power Level	1mW
Tester Name	Jamal Qureshi
Date Tested	Tested on February 27, 2019



SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 1GHz - 7GHz
EUT:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Operating Frequency:	Low Band, High Frequency, 607.875MHz
RF Power Level	1mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on March 4, 2019

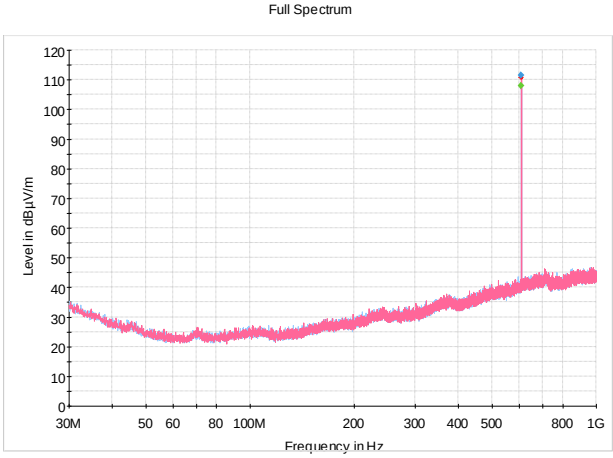


Appendix B

SHURE Radiated RF Emissions Test Report

Common Information

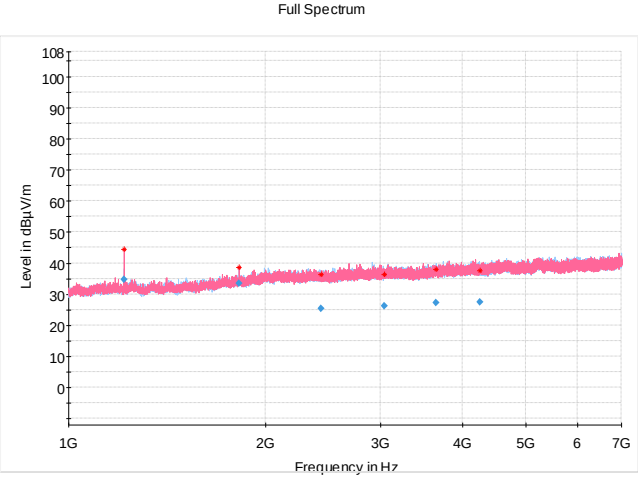
Test Description:	FCC 15C Radiated Emissions 30MHz - 1GHz
EUT	ULXD1 J50A
Serial Number	J5x WMrev02 GC SAMPLE
Operating Frequency:	Low Band, High Frequency, 607.875MHz
RF Power Level	20mW
Tester Name	Jamal Qureshi
Date Tested	Tested on February 27, 2019



SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 1GHz - 6GHz
EUT:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Operating Frequency:	Low Band, High Frequency, 607.875MHz
RF Power Level	20mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on March 4, 2019

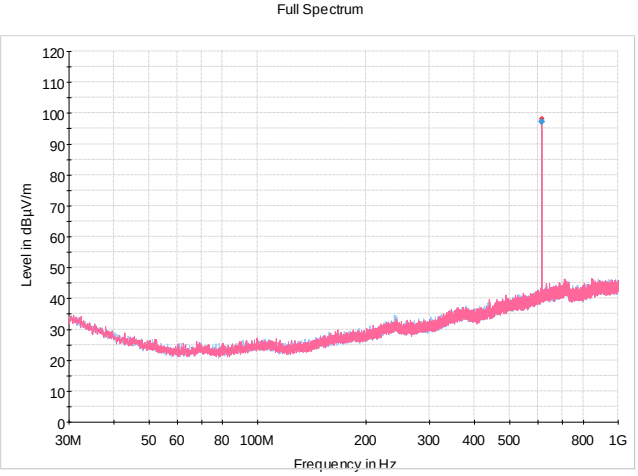


Appendix B

SHURE Radiated RF Emissions Test Report

Common Information

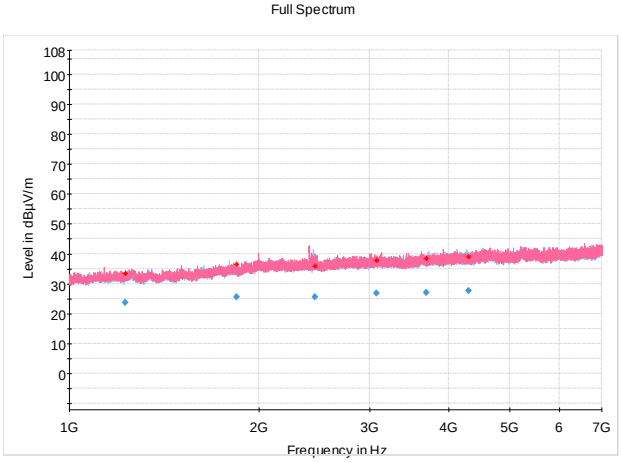
Test Description:	FCC 15C Radiated Emissions 30MHz - 1GHz
EUT	ULXD1 J50A
Serial Number	J5x WMrev02 GC SAMPLE
Operating Frequency:	High Band, Low Frequency, 614.125MHz
RF Power Level	1mW
Tester Name	Jamal Qureshi
Date Tested	Tested on February 27, 2019



SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 1GHz - 7GHz
EUT:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Operating Frequency:	High Band, Low Frequency, 614.125MHz
RF Power Level	1mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on March 4, 2019

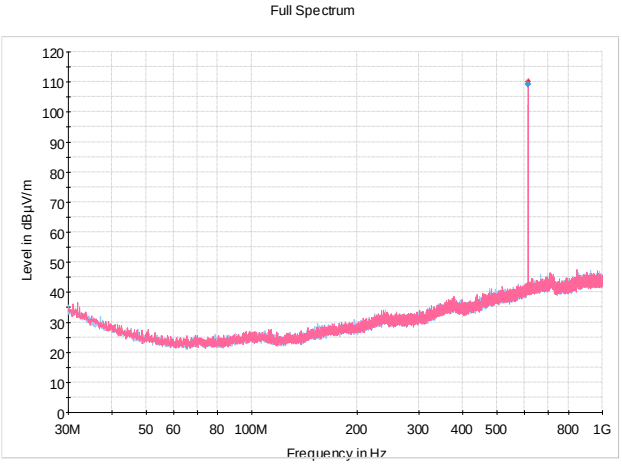


Appendix B

SHURE Radiated RF Emissions Test Report

Common Information

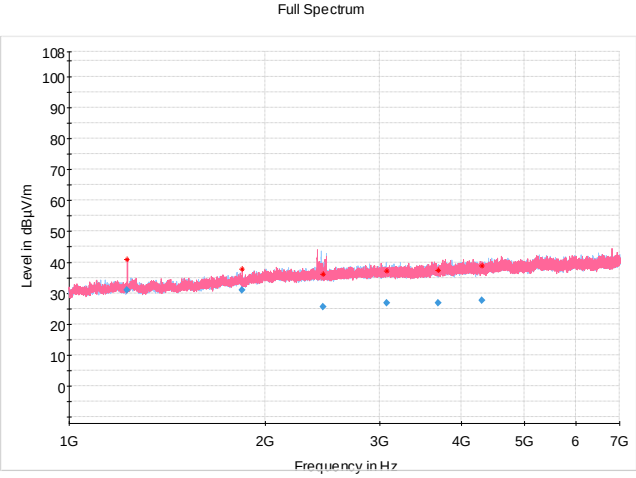
Test Description:	FCC 15C Radiated Emissions 30MHz - 1GHz
EUT	ULXD1 J50A
Serial Number	J5x WMrev02 GC SAMPLE
Operating Frequency:	High Band, Low Frequency, 614.125MHz
RF Power Level	10mW
Tester Name	Jamal Qureshi
Date Tested	Tested on March 1, 2019



SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 1GHz - 7GHz
EUT:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Operating Frequency:	High Band, Low Frequency, 614.125MHz
RF Power Level	10mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on March 1, 2019

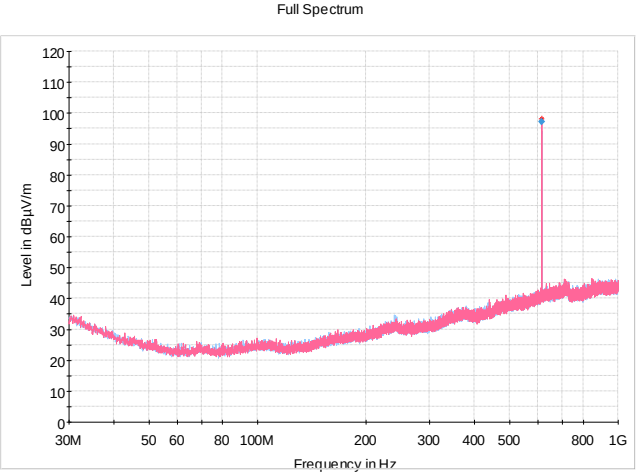


Appendix B

SHURE Radiated RF Emissions Test Report

Common Information

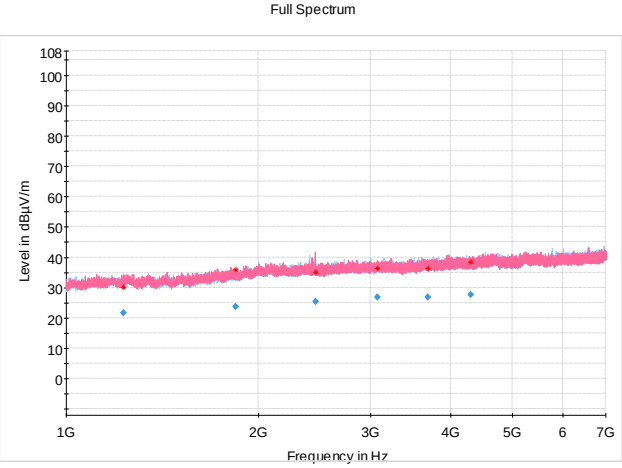
Test Description:	FCC 15C Radiated Emissions 30MHz - 1GHz
EUT	ULXD1 J50A
Serial Number	J5x WMrev02 GC SAMPLE
Operating Frequency:	High Band, High Frequency, 615.875MHz
RF Power Level	1mW
Tester Name	Jamal Qureshi
Date Tested	Tested on February 27, 2019



SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 1GHz - 7GHz
EUT:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Operating Frequency:	High Band, High Frequency, 615.875MHz
RF Power Level	1mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on March 4, 2019

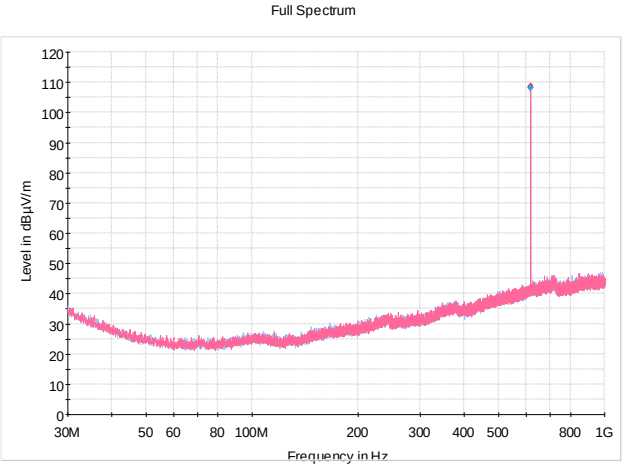


Appendix B

SHURE Radiated RF Emissions Test Report

Common Information

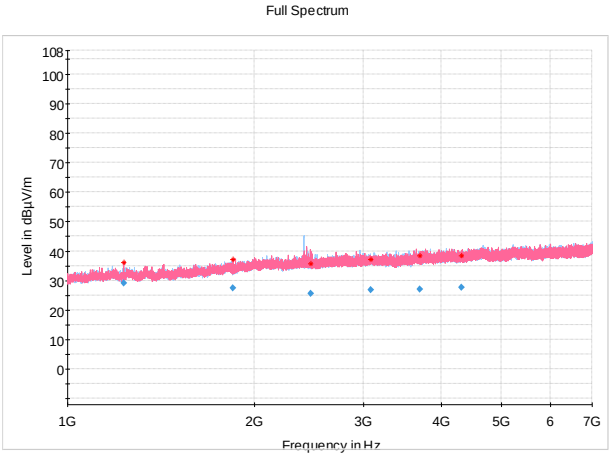
Test Description:	FCC 15C Radiated Emissions 30MHz - 1GHz
EUT	ULXD1 J50A
Serial Number	J5x WMrev02 GC SAMPLE
Operating Frequency:	High Band, High Frequency, 615.875MHz
RF Power Level	10mW
Tester Name	Jamal Qureshi
Date Tested	Tested on March 1, 2019



SHURE Radiated RF Emissions Test Report

Common Information

Test Description:	FCC 15C Radiated Emissions 1GHz - 7GHz
EUT:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Operating Frequency:	High Band, High Frequency, 615.875MHz
RF Power Level	10mW
Tester Name:	Jamal Qureshi
Date Tested	Tested on March 1, 2019



Appendix B

Date: March 6, 2019
EUT: ULXD1
Band: J50A
Serial Number: J5x WMrev02 GC SAMPLE
Specification: EN 300 422-1, Spurious Radiated Emissions
Comments: Test Distance is 3 meters
Mode: EUT set to Low Band, Low Frequency, 572.000MHz, 1mW
Tested By: Jamal Qureshi

Frequency in MHz	Detector Used	Antenna Polarity	Measured Level in dBuV	Matched Sig. Gen. Reading in dBm	Antenna Gain in dB	Cable Loss in dB	ERP Total in dBm	ETSI Limit in dBm
572.000	QP	V	99.37	3.46	0.00	2.75		
1144.000	Average	V	22.73	-77.3	3.43	3.57	-77.46	-30
1716.000	Average	V	31.43	-64.9	5.55	4.20	-63.56	-30
2288.000	Average	V	25.61	-90.0	5.61	4.72	-89.11	-30
2860.000	Average	V	26.43	-90.0	6.89	5.07	-88.18	-30
3432.000	Average	V	26.59	-90.0	8.15	5.47	-87.32	-30
4004.000	Average	V	27.81	-90.0	8.86	6.29	-87.43	-30

Total (dBm) = Matched Signal. Generator Reading (dBm) + Antenna Gain (dB) – Cable Loss (dB)

Date: March 6, 2019
EUT: ULXD1
Band: J50A
Serial Number: J5x WMrev02 GC SAMPLE
Specification: EN 300 422-1, Spurious Radiated Emissions
Comments: Test Distance is 3 meters
Mode: EUT set to Low Band, Low Frequency, 572.000MHz, 20mW
Tested By: Jamal Qureshi

Frequency in MHz	Detector Used	Antenna Polarity	Measured Level in dBuV	Matched Sig. Gen. Reading in dBm	Antenna Gain in dB	Cable Loss in dB	ERP Total in dBm	ETSI Limit in dBm
572.000	QP	V	112.13	16.2	0.00	2.75		
1144.000	Average	V	28.76	-66.8	3.43	3.57	-66.91	-30
1716.000	Average	V	49.45	-46.4	5.55	4.20	-45.00	-30
2288.000	Average	V	25.61	-90.0	5.61	4.72	-89.11	-30
2860.000	Average	V	26.43	-90.0	6.89	5.07	-88.18	-30
3432.000	Average	V	25.59	-90.0	8.15	5.47	-87.32	-30
4004.000	Average	V	27.81	-90.0	8.86	6.29	-87.43	-30

Total (dBm) = Matched Signal. Generator Reading (dBm) + Antenna Gain (dB) – Cable Loss (dB)

Appendix B

Date: March 6, 2019
EUT: ULXD1
Band: J50A
Serial Number: J5x WMrev02 GC SAMPLE
Specification: EN 300 422-1, Spurious Radiated Emissions
Comments: Test Distance is 3 meters
Mode: EUT set to Low Band, Middle Frequency, 589.925MHz, 1mW
Tested By: Jamal Qureshi

Frequency in MHz	Detector Used	Antenna Polarity	Measured Level in dBuV	Matched Sig. Gen. Reading in dBm	Antenna Gain in dB	Cable Loss in dB	ERP Total in dBm	ETSI Limit in dBm
589.925	QP	V	99.26	2.97	0.00	2.76		
1179.850	Average	V	25.10	-71.1	3.56	3.66	-71.22	-30
1769.775	Average	V	24.82	-75.7	5.26	4.24	-74.66	-30
2359.700	Average	V	26.08	-90.0	5.70	4.75	-89.05	-30
2949.625	Average	V	26.66	-90.0	6.97	5.20	-88.23	-30
3539.550	Average	V	27.00	-90.0	8.23	5.56	-87.33	-30
4129.475	Average	V	28.20	-90.0	9.19	6.16	-86.97	-30

Total (dBm) = Matched Signal. Generator Reading (dBm) + Antenna Gain (dB) – Cable Loss (dB)

Date: March 6, 2019
EUT: ULXD1
Band: J50A
Serial Number: J5x WMrev02 GC SAMPLE
Specification: EN 300 422-1, Spurious Radiated Emissions
Comments: Test Distance is 3 meters
Mode: EUT set to Low Band, Middle Frequency, 589.925MHz, 20mW
Tested By: Jamal Qureshi

Frequency in MHz	Detector Used	Antenna Polarity	Measured Level in dBuV	Matched Sig. Gen. Reading in dBm	Antenna Gain in dB	Cable Loss in dB	ERP Total in dBm	ETSI Limit in dBm
589.925	QP	V	112.74	16.45	0.00	2.76		
1179.850	Average	V	34.23	-59.9	3.56	3.66	-59.95	-30
1769.775	Average	V	28.99	-56.4	5.26	4.24	-55.41	-30
2359.700	Average	V	26.07	-90.0	5.70	4.75	-89.05	-30
2949.625	Average	V	26.66	-90.0	6.97	5.20	-88.23	-30
3539.550	Average	V	26.53	-90.0	8.23	5.56	-87.33	-30
4129.475	Average	V	28.20	-90.0	9.19	6.16	-86.97	-30

Total (dBm) = Matched Signal. Generator Reading (dBm) + Antenna Gain (dB) – Cable Loss (dB)

Appendix B

Date: March 6, 2019
EUT: ULXD1
Band: J50A
Serial Number: J5x WMrev02 GC SAMPLE
Specification: EN 300 422-1, Spurious Radiated Emissions
Comments: Test Distance is 3 meters
Mode: EUT set to Low Band, High Frequency, 607.875MHz, 1mW
Tested By: Jamal Qureshi

Frequency in MHz	Detector Used	Antenna Polarity	Measured Level in dBuV	Matched Sig. Gen. Reading in dBm	Antenna Gain in dB	Cable Loss in dB	ERP Total in dBm	ETSI Limit in dBm
607.875	QP	V	97.39	0.84	0.00	2.78		
1215.750	Average	V	24.68	-72.2	3.60	3.68	-72.25	-30
1823.625	Average	V	25.38	-76.0	5.03	4.25	-75.25	-30
2431.500	Average	V	25.84	-90.0	5.81	4.81	-89.00	-30
3039.375	Average	V	26.57	-90.0	7.07	5.25	-88.18	-30
3647.250	Average	V	27.19	-90.0	4.95	6.09	-91.14	-30
4255.125	Average	V	27.92	-90.0	9.45	6.44	-86.99	-30

Total (dBm) = Matched Signal. Generator Reading (dBm) + Antenna Gain (dB) – Cable Loss (dB)

Date: March 6, 2019
EUT: ULXD1
Band: J50A
Serial Number: J5x WMrev02 GC SAMPLE
Specification: EN 300 422-1, Spurious Radiated Emissions
Comments: Test Distance is 3 meters
Mode: EUT set to Low Band, High Frequency, 607.875MHz, 20mW
Tested By: Jamal Qureshi

Frequency in MHz	Detector Used	Antenna Polarity	Measured Level in dBuV	Matched Sig. Gen. Reading in dBm	Antenna Gain in dB	Cable Loss in dB	ERP Total in dBm	ETSI Limit in dBm
607.875	QP	V	111.39	14.83	0.00	2.78		
1215.750	Average	V	34.65	-59.34	3.60	3.68	-59.42	-30
1823.625	Average	V	33.38	-62.52	5.03	4.25	-61.74	-30
2431.500	Average	V	25.48	-90.0	5.81	4.81	-89.00	-30
3039.375	Average	V	26.57	-90.0	7.07	5.25	-88.18	-30
3647.250	Average	V	27.15	-90.0	4.95	6.09	-91.14	-30
4255.125	Average	V	27.92	-90.0	9.45	6.44	-86.99	-30

Appendix B

Date: March 6, 2019
EUT: ULXD1
Band: J50A
Serial Number: J5x WMrev02 GC SAMPLE
Specification: EN 300 422-1, Spurious Radiated Emissions
Comments: Test Distance is 3 meters
Mode: EUT set to High Band, Low Frequency, 614.125MHz, 1mW
Tested By: Jamal Qureshi

Frequency in MHz	Detector Used	Antenna Polarity	Measured Level in dBuV	Matched Sig. Gen. Reading in dBm	Antenna Gain in dB	Cable Loss in dB	ERP Total in dBm	ETSI Limit in dBm
614.125	QP	V	97.09	0.16	0.00	2.80		
1228.250	Average	V	23.79	-73.1	3.56	3.66	-73.17	-30
1842.375	Average	V	25.60	-72.4	5.11	4.33	-71.63	-30
2456.500	Average	V	25.85	-90.0	5.89	4.84	-88.95	-30
3070.625	Average	V	26.99	-90.0	7.11	5.31	-88.20	-30
3684.750	Average	V	27.13	-90.0	8.33	6.06	-87.73	-30
4298.875	Average	V	27.83	-90.0	9.48	6.45	-86.97	-30

Total (dBm) = Matched Signal. Generator Reading (dBm) + Antenna Gain (dB) – Cable Loss (dB)

Date: March 6, 2019
EUT: ULXD1
Band: J50A
Serial Number: J5x WMrev02 GC SAMPLE
Specification: EN 300 422-1, Spurious Radiated Emissions
Comments: Test Distance is 3 meters
Mode: EUT set to High Band, Low Frequency, 614.125MHz, 10mW
Tested By: Jamal Qureshi

Frequency in MHz	Detector Used	Antenna Polarity	Measured Level in dBuV	Matched Sig. Gen. Reading in dBm	Antenna Gain in dB	Cable Loss in dB	ERP Total in dBm	ETSI Limit in dBm
614.125	QP	V	109.27	12.14	0.00	2.80		
1228.250	Average	V	30.88	-62.9	3.56	3.66	-62.96	-30
1842.375	Average	V	31.03	-63.4	5.11	4.33	-62.57	-30
2456.500	Average	V	25.85	-90.0	5.89	4.84	-88.95	-30
3070.625	Average	V	26.99	-90.0	7.11	5.31	-88.20	-30
3684.750	Average	V	27.13	-90.0	8.33	6.06	-87.73	-30
4298.875	Average	V	27.83	-90.0	9.48	6.45	-86.97	-30

Appendix B

Date: March 6, 2019
EUT: ULXD1
Band: J50A
Serial Number: J5x WMrev02 GC SAMPLE
Specification: EN 300 422-1, Spurious Radiated Emissions
Comments: Test Distance is 3 meters
Mode: EUT set to High Band, High Frequency, 615.875MHz, 1mW
Tested By: Jamal Qureshi

Frequency in MHz	Detector Used	Antenna Polarity	Measured Level in dBuV	Matched Sig. Gen. Reading in dBm	Antenna Gain in dB	Cable Loss in dB	ERP Total in dBm	ETSI Limit in dBm
615.875	QP	V	97.87	0.54	0.00	2.84		
1231.750	Average	V	22.21	-90.0	3.54	3.66	-90.12	-30
1847.625	Average	V	23.98	-90.0	5.13	4.29	-89.16	-30
2463.500	Average	V	25.91	-90.0	5.90	4.85	-88.95	-30
3079.375	Average	V	27.12	-90.0	7.13	5.24	-88.11	-30
33695.250	Average	V	27.31	-90.0	8.33	6.90	-87.57	-30
4311.125	Average	V	27.92	-90.0	9.48	6.65	-87.17	-30

Total (dBm) = Matched Signal. Generator Reading (dBm) + Antenna Gain (dB) – Cable Loss (dB)

Date: March 6, 2019
EUT: ULXD1
Band: J50A
Serial Number: J5x WMrev02 GC SAMPLE
Specification: EN 300 422-1, Spurious Radiated Emissions
Comments: Test Distance is 3 meters
Mode: EUT set to High Band, High Frequency, 615.875MHz, 10mW
Tested By: Jamal Qureshi

Frequency in MHz	Detector Used	Antenna Polarity	Measured Level in dBuV	Matched Sig. Gen. Reading in dBm	Antenna Gain in dB	Cable Loss in dB	ERP Total in dBm	ETSI Limit in dBm
615.875	QP	V	108.25	11.09	0.00	2.80		
1231.750	Average	V	29.21	-46.3	3.54	3.66	-46.44	-30
1847.625	Average	V	27.49	-51.0	5.13	4.29	-50.12	-30
2463.500	Average	V	25.91	-90.0	5.90	4.85	-88.95	-30
3079.375	Average	V	27.11	-90.0	7.13	5.24	-88.11	-30
3695.250	Average	V	27.31	-90.0	8.33	5.90	-87.57	-30
4311.125	Average	V	27.92	-90.0	9.48	6.65	-87.17	-30

Appendix C

Maximum Radiated Power

Purpose:

This test performed to determine if the EUT meets the Maximum Radiated Power requirements of the FCC Part15C, Section 15.236, the FCC OET Basic Certification Requirements for Wireless Microphones, and RSS-210 Annex G.

Requirements:

As stated in FCC 15C Section 15.236 (6)(2). the FCC OET Basic Certification Requirements for Wireless Microphones, and RSS-210 Annex G.

Measurement Uncertainty:

All measurements are an estimate of their true value. The measurement uncertainty characterizes, with a specified confidence level, the spread of values which may be possible for a given measurement system.

Values of Expanded Measurement Uncertainty (95% Confidence)

Measurement Type	U_{lab}
Radiated measurements (30 MHz – 1000 MHz)	4.24 dB

U_{lab} = Determined for Shure EMC Laboratory

Since U_{lab} is less than or equal to U_{ETSI}:

- Compliance is deemed to occur if no measured disturbance exceeds the disturbance limit; Non-compliance is deemed to occur if any measured disturbance exceeds the disturbance limit.

Test Setup and Instrumentation:

Photographs of the test setup are shown in Figure B 1. The test instrumentation can be determined from Table 10-1.

EUT Operation:

The EUT was powered up and the frequency of the transmitter was selected using the front panel controls. For rated output power, the testing was performed with the EUT set to the Low Band, 572.000, 589.925, 607.875, with RF power output of 1mW and 20mW, and the High Band, 614.125 and 615.875, with RF power output of 1mW and 10mW.

Appendix C

Specific Test Procedures:

The Maximum Rated Power test was performed during the Spurious Emission testing, Appendix B. The carrier frequency power level was documented in Appendix B.

Results:

The EIRP for all frequencies measured meets the FCC15C 15.236 requirements, the FCC OET Basic Certification Requirements for Wireless Microphones requirements, and RSS-210 Annex G.

The results are shown on page 47 thru page 56.

Appendix C

Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	Maximum Rated Output
Operating Conditions:	EUT set to Low Band, Low Frequency, 572.000MHz, 1mW
Operator Name:	Jamal Qureshi
Comment:	FCC Part15C, Section 15.236
Date Tested:	Tested on March 6, 2019

Measured in RF Chamber in dBuV	Substitution Signal Generator Measurement in dBm	Equivalent Antenna Gain in dB	Cable Loss in dB	EIRP in dBm	EIRP in mW	EIRP Limit in mW	Margin In mW
99.37	3.46	2.15	2.75	2.86	1.93	50.00	48.07

EIRP (dBm) = Measurement (dBm) + Equivalent Antenna Gain (dB) - Cable Loss (dB)

Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	Maximum Rated Output
Operating Conditions:	EUT set to Low Band, Low Frequency, 572.000MHz, 20mW
Operator Name:	Jamal Qureshi
Comment:	FCC Part15C, Section 15.236
Date Tested:	Tested on March 6, 2019

Measured in RF Chamber in dBuV	Substitution Signal Generator Measurement in dBm	Equivalent Antenna Gain in dB	Cable Loss in dB	EIRP in dBm	EIRP in mW	EIRP Limit in mW	Margin In mW
112.13	+16.19	2.15	2.75	15.59	36.22	50.00	13.78

EIRP (dBm) = Measurement (dBm) + Equivalent Antenna Gain (dB) - Cable Loss (dB)

Appendix C

Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	Maximum Rated Output
Operating Conditions:	EUT set to Low Band, Middle Frequency, 589.925MHz, 1mW
Operator Name:	Jamal Qureshi
Comment:	FCC Part15C, Section 15.236
Date Tested:	Tested on March 6, 2019

Measured in RF Chamber in dBuV	Substitution Signal Generator Measurement in dBm	Equivalent Antenna Gain in dB	Cable Loss in dB	EIRP in dBm	EIRP in mW	EIRP Limit in mW	Margin In mW
99.26	2.97	2.15	2.76	2.36	1.72	50.00	48.28

EIRP (dBm) = Measurement (dBm) + Equivalent Antenna Gain (dB) - Cable Loss (dB)

Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	Maximum Rated Output
Operating Conditions:	EUT set to Low Band, Middle Frequency, 589.925MHz, 20mW
Operator Name:	Jamal Qureshi
Comment:	FCC Part15C, Section 15.236
Date Tested:	Tested on March 6, 2019

Measured in RF Chamber in dBuV	Substitution Signal Generator Measurement in dBm	Equivalent Antenna Gain in dB	Cable Loss in dB	EIRP in dBm	EIRP in mW	EIRP Limit in mW	Margin In mW
111.74	+16.45	2.15	2.76	15.84	38.37	50.00	11.63

EIRP (dBm) = Measurement (dBm) + Equivalent Antenna Gain (dB) - Cable Loss (dB)

Appendix C

Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	Maximum Rated Output
Operating Conditions:	EUT set to Low Band, High Frequency, 607.875MHz, 1mW
Operator Name:	Jamal Qureshi
Comment:	FCC Part15C, Section 15.236
Date Tested:	Tested on March 6, 2019

Measured in RF Chamber in dBuV	Substitution Signal Generator Measurement in dBm	Equivalent Antenna Gain in dB	Cable Loss in dB	EIRP in dBm	EIRP in mW	EIRP Limit in mW	Margin In dB
97.39	0.84	2.15	2.78	0.21	1.05	50.00	48.95

EIRP (dBm) = Measurement (dBm) + Equivalent Antenna Gain (dB) - Cable Loss (dB)

Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	Maximum Rated Output
Operating Conditions:	EUT set to Low Band, High Frequency, 607.875MHz, 20mW
Operator Name:	Jamal Qureshi
Comment:	FCC Part15C, Section 15.236
Date Tested:	Tested on March 6, 2019

Measured in RF Chamber in dBuV	Substitution Signal Generator Measurement in dBm	Equivalent Antenna Gain in dB	Cable Loss in dB	EIRP in dBm	EIRP in mW	EIRP Limit in mW	Margin In dB
111.39	+14.83	2.15	2.78	14.20	26.30	50.00	23.70

EIRP (dBm) = Measurement (dBm) + Equivalent Antenna Gain (dB) - Cable Loss (dB)

Appendix C

Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	Maximum Rated Output
Operating Conditions:	EUT set to High Band, Low Frequency, 614.125MHz, 1mW
Operator Name:	Jamal Qureshi
Comment:	FCC Part15C, Section 15.236
Date Tested:	Tested on March 6, 2019

Measured in RF Chamber in dBuV	Substitution Signal Generator Measurement in dBm	Equivalent Antenna Gain in dB	Cable Loss in dB	EIRP in dBm	EIRP in mW	EIRP Limit in mW	Margin In dB
97.09	0.16	2.15	2.80	-0.49	0.89	50.00	49.11

EIRP (dBm) = Measurement (dBm) + Equivalent Antenna Gain (dB) - Cable Loss (dB)

Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	Maximum Rated Output
Operating Conditions:	EUT set to High Band, Low Frequency, 614.125MHz, 10mW
Operator Name:	Jamal Qureshi
Comment:	FCC Part15C, Section 15.236
Date Tested:	Tested on March 6, 2019

Measured in RF Chamber in dBuV	Substitution Signal Generator Measurement in dBm	Equivalent Antenna Gain in dB	Cable Loss in dB	EIRP in dBm	EIRP in mW	EIRP Limit in mW	Margin In dB
109.27	+12.14	2.15	2.80	11.49	14.09	50.00	35.91

EIRP (dBm) = Measurement (dBm) + Equivalent Antenna Gain (dB) - Cable Loss (dB)

Appendix C

Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	Maximum Rated Output
Operating Conditions:	EUT set to High Band, High Frequency, 615.875MHz, 1mW
Operator Name:	Jamal Qureshi
Comment:	FCC Part15C, Section 15.236
Date Tested:	Tested on March 6, 2019

Measured in RF Chamber in dBuV	Substitution Signal Generator Measurement in dBm	Equivalent Antenna Gain in dB	Cable Loss in dB	EIRP in dBm	EIRP in mW	EIRP Limit in mW	Margin In dB
97.87	0.54	2.15	2.84	-0.15	0.97	50.00	49.03

EIRP (dBm) = Measurement (dBm) + Equivalent Antenna Gain (dB) - Cable Loss (dB)

Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	Maximum Rated Output
Operating Conditions:	EUT set to High Band, High Frequency, 615.875MHz, 10mW
Operator Name:	Jamal Qureshi
Comment:	FCC Part15C, Section 15.236
Date Tested:	Tested on March 6, 2019

Measured in RF Chamber in dBuV	Substitution Signal Generator Measurement in dBm	Equivalent Antenna Gain in dB	Cable Loss in dB	EIRP in dBm	EIRP in mW	EIRP Limit in mW	Margin In dB
108.25	+11.09	2.15	2.84	10.40	10.97	50.00	39.03

EIRP (dBm) = Measurement (dBm) + Equivalent Antenna Gain (dB) - Cable Loss (dB)

Appendix C

Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	Maximum Rated Output
Operating Conditions:	EUT set to Low Band, Low Frequency, 572.000MHz, 1mW
Operator Name:	Jamal Qureshi
Comment:	RSS-210
Date Tested:	Tested on March 6, 2019

Measured in RF Chamber in dBuV	Substitution Signal Generator Measurement in dBm	Equivalent Antenna Gain in dB	Cable Loss in dB	EIRP in dBm	EIRP in mW	EIRP Limit in mW	Margin In mW
99.37	3.46	2.15	2.75	2.86	1.94	250.00	248.06

EIRP (dBm) = Measurement (dBm) + Equivalent Antenna Gain (dB) - Cable Loss (dB)

Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	Maximum Rated Output
Operating Conditions:	EUT set to Low Band, Low Frequency, 572.000MHz, 20mW
Operator Name:	Jamal Qureshi
Comment:	RSS-210
Date Tested:	Tested on March 6, 2019

Measured in RF Chamber in dBuV	Substitution Signal Generator Measurement in dBm	Equivalent Antenna Gain in dB	Cable Loss in dB	EIRP in dBm	EIRP in mW	EIRP Limit in mW	Margin In mW
112.13	+16.19	2.15	2.75	15.59	36.22	250.00	213.78

EIRP (dBm) = Measurement (dBm) + Equivalent Antenna Gain (dB) - Cable Loss (dB)

Appendix C

Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	Maximum Rated Output
Operating Conditions:	EUT set to Low Band, Middle Frequency, 589.925MHz, 1mW
Operator Name:	Jamal Qureshi
Comment:	RSS-210
Date Tested:	Tested on March 6, 2019

Measured in RF Chamber in dBuV	Substitution Signal Generator Measurement in dBm	Equivalent Antenna Gain in dB	Cable Loss in dB	EIRP in dBm	EIRP in mW	EIRP Limit in mW	Margin In mW
99.26	2.97	2.15	2.76	2.36	1.72	250.00	248.28

EIRP (dBm) = Measurement (dBm) + Equivalent Antenna Gain (dB) - Cable Loss (dB)

Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	Maximum Rated Output
Operating Conditions:	EUT set to Low Band, Middle Frequency, 589.925MHz, 20mW
Operator Name:	Jamal Qureshi
Comment:	RSS-210
Date Tested:	Tested on March 6, 2019

Measured in RF Chamber in dBuV	Substitution Signal Generator Measurement in dBm	Equivalent Antenna Gain in dB	Cable Loss in dB	EIRP in dBm	EIRP in mW	EIRP Limit in mW	Margin In mW
112.74	+16.45	2.15	2.76	15.84	38.37	250.00	211.63

EIRP (dBm) = Measurement (dBm) + Equivalent Antenna Gain (dB) - Cable Loss (dB)

Appendix C

Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	Maximum Rated Output
Operating Conditions:	EUT set to Low Band, High Frequency, 607.875MHz, 1mW
Operator Name:	Jamal Qureshi
Comment:	RSS-210
Date Tested:	Tested on March 6, 2019

Measured in RF Chamber in dBuV	Substitution Signal Generator Measurement in dBm	Equivalent Antenna Gain in dB	Cable Loss in dB	EIRP in dBm	EIRP in mW	EIRP Limit in mW	Margin In dB
97.39	0.84	2.15	2.78	0.21	1.05	250.00	248.95

EIRP (dBm) = Measurement (dBm) + Equivalent Antenna Gain (dB) - Cable Loss (dB)

Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	Maximum Rated Output
Operating Conditions:	EUT set to Low Band, High Frequency, 607.875MHz, 20mW
Operator Name:	Jamal Qureshi
Comment:	RSS-210
Date Tested:	Tested on March 6, 2019

Measured in RF Chamber in dBuV	Substitution Signal Generator Measurement in dBm	Equivalent Antenna Gain in dB	Cable Loss in dB	EIRP in dBm	EIRP in mW	EIRP Limit in mW	Margin In dB
111.39	+14.83	2.15	2.78	14.20	26.30	250.00	223.70

EIRP (dBm) = Measurement (dBm) + Equivalent Antenna Gain (dB) - Cable Loss (dB)

Appendix C

Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	Maximum Rated Output
Operating Conditions:	EUT set to High Band, Low Frequency, 614.125MHz, 1mW
Operator Name:	Jamal Qureshi
Comment:	RSS-210
Date Tested:	Tested on March 6, 2019

Measured in RF Chamber in dBuV	Substitution Signal Generator Measurement in dBm	Equivalent Antenna Gain in dB	Cable Loss in dB	EIRP in dBm	EIRP in mW	EIRP Limit in mW	Margin In dB
97.09	0.16	2.15	2.80	-0.49	0.89	250.00	249.11

EIRP (dBm) = Measurement (dBm) + Equivalent Antenna Gain (dB) - Cable Loss (dB)

Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	Maximum Rated Output
Operating Conditions:	EUT set to High Band, Low Frequency, 614.125MHz, 10mW
Operator Name:	Jamal Qureshi
Comment:	RSS-210
Date Tested:	Tested on March 6, 2019

Measured in RF Chamber in dBuV	Substitution Signal Generator Measurement in dBm	Equivalent Antenna Gain in dB	Cable Loss in dB	EIRP in dBm	EIRP in mW	EIRP Limit in mW	Margin In dB
109.27	+12.14	2.15	2.80	11.49	14.09	250.00	235.91

EIRP (dBm) = Measurement (dBm) + Equivalent Antenna Gain (dB) - Cable Loss (dB)

Appendix C

Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	Maximum Rated Output
Operating Conditions:	EUT set to High Band, High Frequency, 615.875MHz, 1mW
Operator Name:	Jamal Qureshi
Comment:	RSS-210
Date Tested:	Tested on March 6, 2019

Measured in RF Chamber in dBuV	Substitution Signal Generator Measurement in dBm	Equivalent Antenna Gain in dB	Cable Loss in dB	EIRP in dBm	EIRP in mW	EIRP Limit in mW	Margin In dB
97.87	0.54	2.15	2.84	-0.15	0.97	250.00	249.03

EIRP (dBm) = Measurement (dBm) + Equivalent Antenna Gain (dB) - Cable Loss (dB)

Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	Maximum Rated Output
Operating Conditions:	EUT set to High Band, High Frequency, 615.875MHz, 10mW
Operator Name:	Jamal Qureshi
Comment:	RSS-210
Date Tested:	Tested on March 6, 2019

Measured in RF Chamber in dBuV	Substitution Signal Generator Measurement in dBm	Equivalent Antenna Gain in dB	Cable Loss in dB	EIRP in dBm	EIRP in mW	EIRP Limit in mW	Margin In dB
108.25	+11.09	2.15	2.84	10.40	10.97	250.00	239.03

EIRP (dBm) = Measurement (dBm) + Equivalent Antenna Gain (dB) - Cable Loss (dB)

Appendix D

FREQUENCY TOLERANCE

PURPOSE:

This test was performed to determine if the EUT meets the frequency stability requirements of the FCC Part 15C, Section 15.236(f)(3) and the RSS-210 Annex G Table G1, specifications over the EUT operating frequency range of 470MHz to 534MHz.

REQUIREMENTS:

As stated in paragraph 15.236(f)(3) and, for low power auxiliary stations operating in the bands allocated for TV broadcasting, the frequency tolerance of the transmitter shall be 0.005 percent. RSS-210 Annex G Table G1 require ±50ppm.

MEASUREMENT UNCERTAINTY:

All measurements are an estimate of their true value. The measurement uncertainty characterizes, with a specified confidence level, the spread of values which may be possible for a given measurement system.

Values of Expanded Measurement Uncertainty (95% Confidence):

Measurement Type	U_{lab}
Frequency Error (Stability)	.0000000583 ppm

U_{lab} = Determined for Shure EMC Laboratory

- Compliance is deemed to occur if no measured disturbance exceeds the disturbance limit;
- Non-compliance is deemed to occur if any measured disturbance exceeds the disturbance limit.

TEST SETUP AND INSTRUMENTATION:

The EUT firmware was temporarily changed to transmit a CW signal just for this test. The EUT was heated and cooled in an ESPEC temperature chamber over a temperature range of -30C to +50C. The temperature around the EUT was measured and monitored by a J-Type thermocouple connected to an Extech thermometer. The EUTs frequency was measured with a frequency counter set to measure signal count at 0.1Hz resolution. The EUT was measured at low, middle, and high frequencies in the low band, and low and high frequencies in the high band. Photographs of the test setup are shown as Figure D-1. The test instrumentation can be determined from Table 10-1.

EUT OPERATION:

The antenna port of the EUT was connected to the 50 Ohm input of a frequency counter. The EUT was operated at 10mW.

Appendix D

TEST PROCEDURES:

a. The temperature chamber was set to 20C, ambient temperature, with the EUT inside and powered on.

b. The EUT was allowed to soak for at least 15 minutes after the temperature chamber reached the set temperature.

c. The measured frequency of the transmitter was measured on the frequency counter.

d. Steps a. through c. were repeated at -30C through +50C in ten degree increments for representative low, mid and high frequencies within the EUTs operational band.

RESULTS:

The frequency stability measurements are presented on pages 59 and 60. As shown by the test data, the test frequency deviation was within the 0.005 percent limit set out in the FCC Part 15C Section 15.236(f)(3) and the RSS-210 specifications.

The temperature in the test room during the test was 75 degrees F, with relative humidity of 18%.

Figures D-1 - Test Setup for Frequency Stability

Appendix D

Test Information

EUT Name: ULXD1 J50A
Serial Number: J5x WMrev02 GC SAMPLE
Test Description: FCC Part 15C Section 15.236(f)(3) Frequency Tolerance
Operating Conditions: Low Band: Low, Middle, and High frequency at 10mW, -30C to +50C
Operator Name: Juan Castrejon
Comment: R & S FSU Spectrum Analyzer and ESPEC Temp Chamber
Test Date March 8, 2019

Temp °C	Nominal Frequency (MHz)	Measured Frequency (MHz)	Deviation (%)	Frequency Stability (%)	Deviation (Hz)	PPM	Pass Or Fail
-30	572.000	572.000116	0.000020	0.005	116.16	0.203077	PASS
-20	572.000	572.000154	0.000027	0.005	154.32	0.269790	PASS
-10	572.000	572.000320	0.000056	0.005	320.22	0.559825	PASS
0	572.000	572.000398	0.000070	0.005	389.11	0.695997	PASS
10	572.000	572.000433	0.000076	0.005	433.10	0.757168	PASS
20	572.000	572.000444	0.000078	0.005	444.17	0.776521	PASS
30	572.000	572.000436	0.000076	0.005	436.44	0.763007	PASS
40	572.000	572.000456	0.000080	0.005	455.74	0.796748	PASS
50	572.000	572.000494	0.000086	0.005	494.03	0.863689	PASS
-30	589.925	589.925123	0.000021	0.005	123.48	0.209315	PASS
-20	589.925	589.925153	0.000026	0.005	152.88	0.259152	PASS
-10	589.925	589.925310	0.000053	0.005	310.44	0.526236	PASS
0	589.925	589.925410	0.000069	0.005	409.55	0.694241	PASS
10	589.925	589.925446	0.000076	0.005	445.70	0.755520	PASS
20	589.925	589.925458	0.000078	0.005	458.00	0.776370	PASS
30	589.925	589.925449	0.000076	0.005	449.33	0.761673	PASS
40	589.925	589.925478	0.000081	0.005	477.74	0.809832	PASS
50	589.925	589.925506	0.000086	0.005	505.66	0.857160	PASS
-30	607.875	607.875132	0.000022	0.005	131.55	0.216410	PASS
-20	607.875	607.875157	0.000026	0.005	156.55	0.257537	PASS
-10	607.875	607.875316	0.000052	0.005	315.55	0.519103	PASS
0	607.875	607.875420	0.000069	0.005	419.55	0.690191	PASS
10	607.875	607.875459	0.000075	0.005	458.70	0.754596	PASS
20	607.875	607.875473	0.000078	0.005	472.80	0.777791	PASS
30	607.875	607.875463	0.000076	0.005	463.44	0.762394	PASS
40	607.875	607.875497	0.000082	0.005	497.34	0.818162	PASS
50	607.875	607.875507	0.000083	0.005	507.32	0.834579	PASS

Appendix D

Test Information

EUT Name: ULXD1 J50A
Serial Number: J5x WMrev02 GC SAMPLE
Test Description: FCC Part 15C Section 15.236(f)(3) Frequency Tolerance
Operating Conditions: High Band: Low and High frequency at 10mW, -30C to +50C
Operator Name: Juan Castrejon
Comment: R & S FSU Spectrum Analyzer and ESPEC Temp Chamber
Test Date March 8, 2019

Temp °C	Nominal Frequency (MHz)	Measured Frequency (MHz)	Deviation (%)	Frequency Stability (%)	Deviation (Hz)	PPM	Pass Or Fail
-30	614.125	614.125137	0.000022	0.005	137.44	0.223798	PASS
-20	614.125	614.125152	0.000025	0.005	151.50	0.246692	PASS
-10	614.125	614.125317	0.000052	0.005	316.60	0.515530	PASS
0	614.125	614.125423	0.000069	0.005	423.14	0.689013	PASS
10	614.125	614.125461	0.000075	0.005	461.10	0.750824	PASS
20	614.125	614.125478	0.000078	0.005	478.11	0.778824	PASS
30	614.125	614.125467	0.000076	0.005	467.11	0.760611	PASS
40	614.125	614.125510	0.000083	0.005	510.11	0.830629	PASS
50	614.125	614.125509	0.000083	0.005	509.30	0.829310	PASS
-30	615.875	615.875139	0.000023	0.005	139.32	0.226215	PASS
-20	615.875	615.875119	0.000019	0.005	119.17	0.193497	PASS
-10	615.875	615.875320	0.000052	0.005	319.77	0.519213	PASS
0	615.875	615.875424	0.000069	0.005	423.83	0.688175	PASS
10	615.875	615.875460	0.000075	0.005	459.60	0.746255	PASS
20	615.875	615.875482	0.000078	0.005	482.17	0.782902	PASS
30	615.875	615.875468	0.000076	0.005	468.22	0.760252	PASS
40	615.875	615.875515	0.000084	0.005	514.72	0.835754	PASS
50	615.875	615.875505	0.000082	0.005	505.17	0.820248	PASS

Appendix E

Spurious Emissions at Antenna Terminals

Purpose:

This test performed to determine if the EUT meets the conducted spurious emissions at the antenna port requirements of the FCC Part 2.1051.

Requirements:

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in §2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

Measurement Uncertainty:

All measurements are an estimate of their true value. The measurement uncertainty characterizes, with a specified confidence level, the spread of values which may be possible for a given measurement system.
The expanded measurement uncertainty (95% confidence) has been determined to be ± 1.28 dB.

Test Setup and Instrumentation:

Photograph of the test setup is shown in Figure E 1.The test instrumentation can be determined from Table 10-1.

EUT Operation:

The EUT was powered up and the frequency of the transmitter was selected using the front panel controls. For conducted spurious emissions the testing was performed with the EUT set to the Low Band, low, middle, and high frequencies with RF power output of 1mW and 20mW. Then the High Band, low and high frequencies with RF power output of 1mW and 10mW.

Appendix E

Specific Test Procedures:

The testing was performed as states in FCC Part 2.1051.

Results:

The plots of the antenna port spurious emissions are shown on page 63 thru page 72. All emissions measured from the EUT were within the ETSI EN 300 422-1 specification limits. All spurious emissions were at least

The temperature during the testing was 76 degrees F, with relative humidity of 17%.

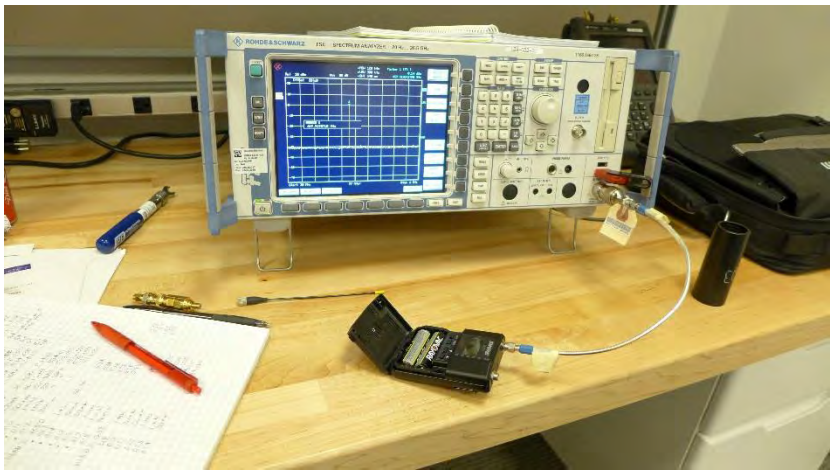
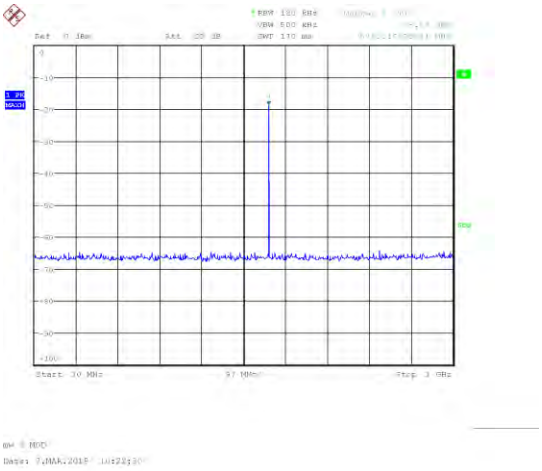


Figure E 1: ULXD1 Transmitter Test Setup

Appendix E

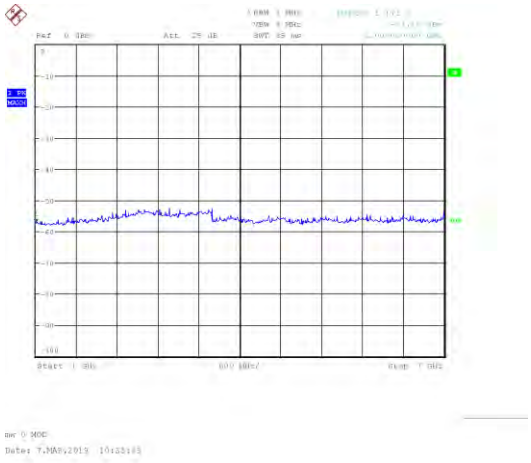
Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	2.1051 Spurious Emissions at Antenna Port
Operating Conditions:	Low Band, Low Frequency, 572.000MHz, 1mW
Frequency Range	30MHz to 1000MHz
Operator Name:	Craig Kozokar
Date Tested:	Tested on March 7, 2019



Test Information

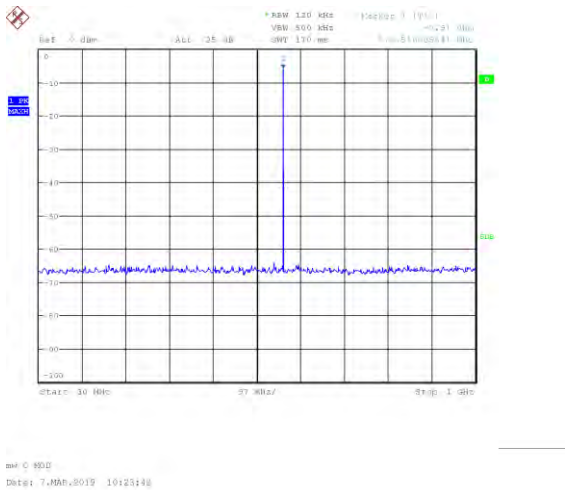
EUT Name:	ULXD1 j50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	2.1051 Spurious Emissions at Antenna Port
Operating Conditions:	Low Band, Low Frequency, 572.000MHz, 1mW
Frequency Range	1GHz to 7GHz
Operator Name:	Craig Kozokar
Date Tested:	Tested on March 7, 2019



Appendix E

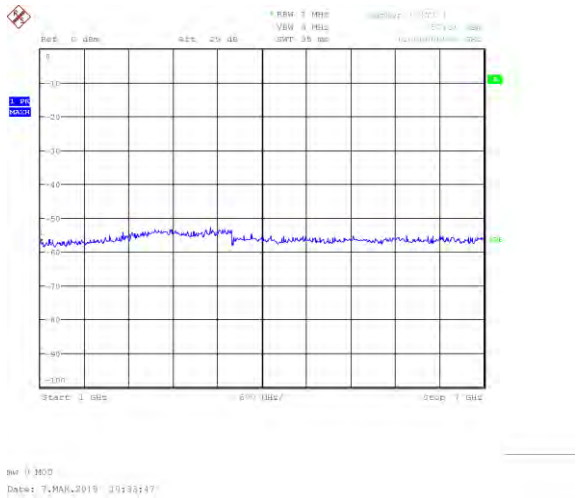
Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	2.1051 Spurious Emissions at Antenna Port
Operating Conditions:	Low Band, Low Frequency, 572.000MHz, 20mW
Frequency Range	30MHz to 1000MHz
Operator Name:	Craig Kozokar
Date Tested:	Tested on March 7, 2019



Test Information

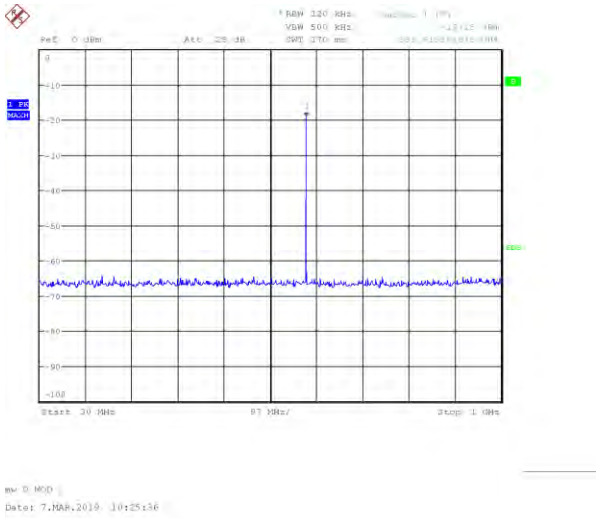
EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	2.1051 Spurious Emissions at Antenna Port
Operating Conditions:	Low Band, Low Frequency, 572.000MHz, 20mW
Frequency Range	1GHz to 7GHz
Operator Name:	Craig Kozokar
Date Tested:	Tested on March 7, 2019



Appendix E

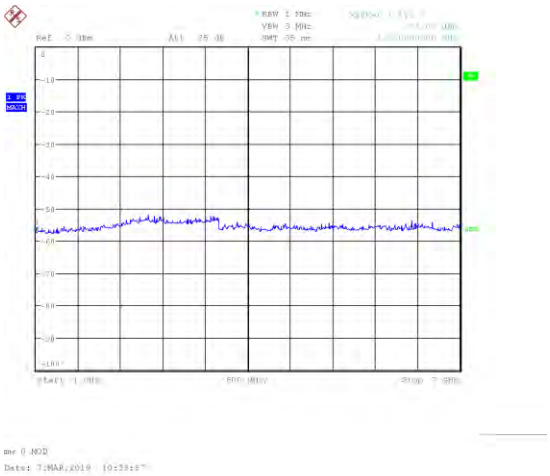
Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	2.1051 Spurious Emissions at Antenna Port
Operating Conditions:	Low Band, Middle Frequency, 589.925MHz, 1mW
Frequency Range	30MHz to 1000MHz
Operator Name:	Craig Kozokar
Date Tested:	Tested on March 7, 2019



Test Information

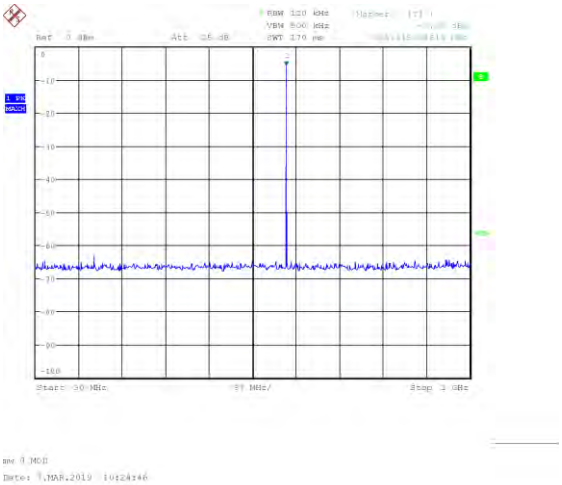
EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	2.1051 Spurious Emissions at Antenna Port
Operating Conditions:	Low Band, Middle Frequency, 589.925MHz, 1mW
Frequency Range	1GHz to 7GHz
Operator Name:	Craig Kozokar
Date Tested:	Tested on March 7, 2019



Appendix E

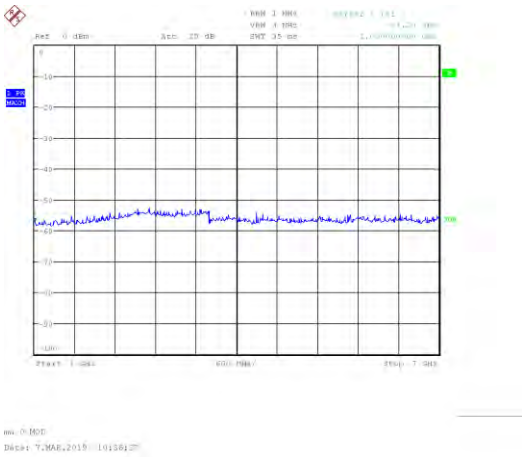
Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	2.1051 Spurious Emissions at Antenna Port
Operating Conditions:	Low Band, Middle Frequency, 589.925MHz, 20mW
Frequency Range	30MHz to 1000MHz
Operator Name:	Craig Kozokar
Date Tested:	Tested on March 7, 2019



Test Information

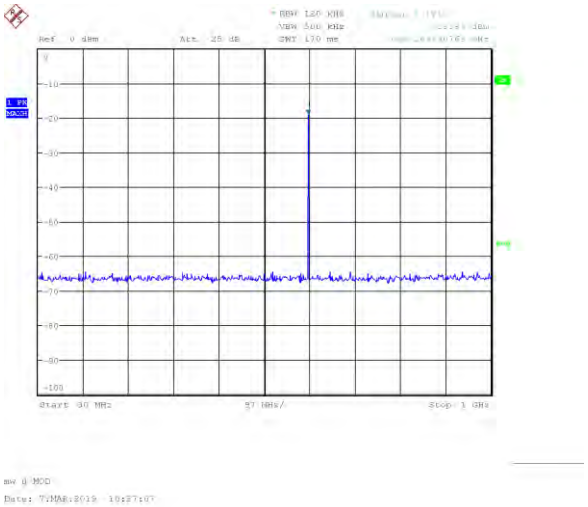
EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	2.1051 Spurious Emissions at Antenna Port
Operating Conditions:	Low Band, Middle Frequency, 589.925MHz, 20mW
Frequency Range	1GHz to 7GHz
Operator Name:	Craig Kozokar
Date Tested:	Tested on March 7, 2019



Appendix E

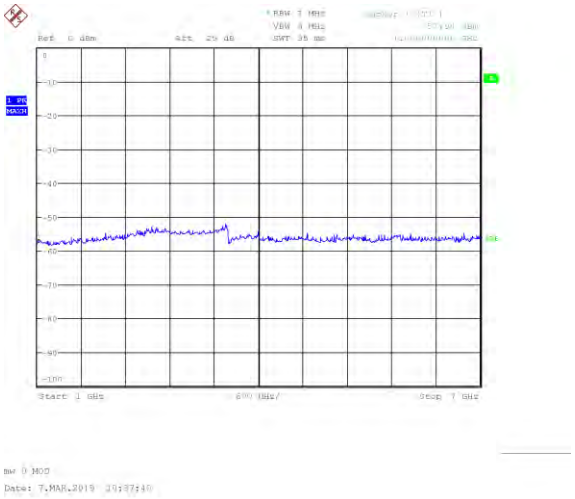
Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	2.1051 Spurious Emissions at Antenna Port
Operating Conditions:	Low Band, High Frequency, 607.875MHz, 1mW
Frequency Range	30MHz to 1000MHz
Operator Name:	Craig Kozokar
Date Tested:	Tested on March 7, 2019



Test Information

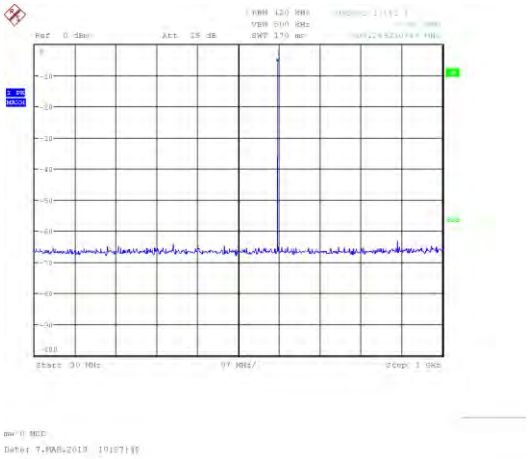
EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	2.1051 Spurious Emissions at Antenna Port
Operating Conditions:	Low Band, High Frequency, 607.875MHz, 1mW
Frequency Range	1GHz to 7GHz
Operator Name:	Craig Kozokar
Date Tested:	Tested on March 7, 2019



Appendix E

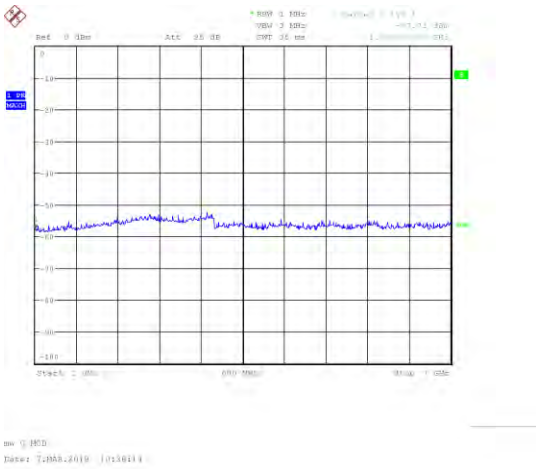
Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	2.1051 Spurious Emissions at Antenna Port
Operating Conditions:	Low Band, High Frequency, 607.875MHz, 20mW
Frequency Range	30MHz to 1000MHz
Operator Name:	Craig Kozokar
Date Tested:	Tested on March 7, 2019



Test Information

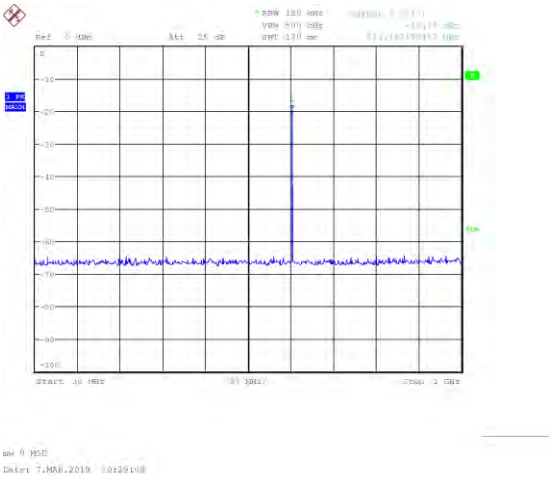
EUT Name:	ULXD1 J50A
Serial Number:	WMrev02 GC SAMPLE
Test Description:	2.1051 Spurious Emissions at Antenna Port
Operating Conditions:	Low Band, High Frequency, 607.875MHz, 20mW
Frequency Range	1GHz to 7GHz
Operator Name:	Craig Kozokar
Date Tested:	Tested on March 7, 2019



Appendix E

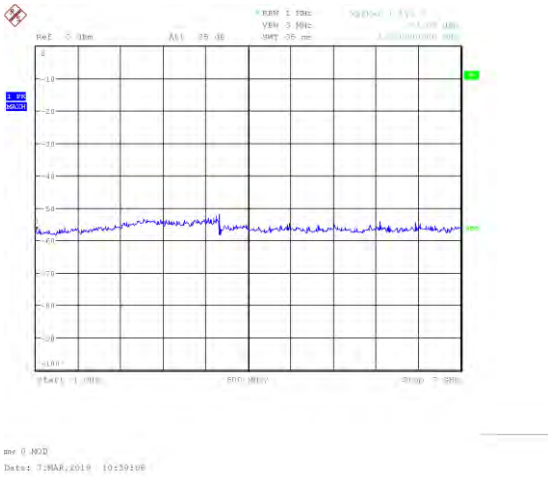
Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	2.1051 Spurious Emissions at Antenna Port
Operating Conditions:	High Band, Low Frequency, 614.125MHz, 1mW
Frequency Range	30MHz to 1000MHz
Operator Name:	Craig Kozokar
Date Tested:	Tested on March 7, 2019



Test Information

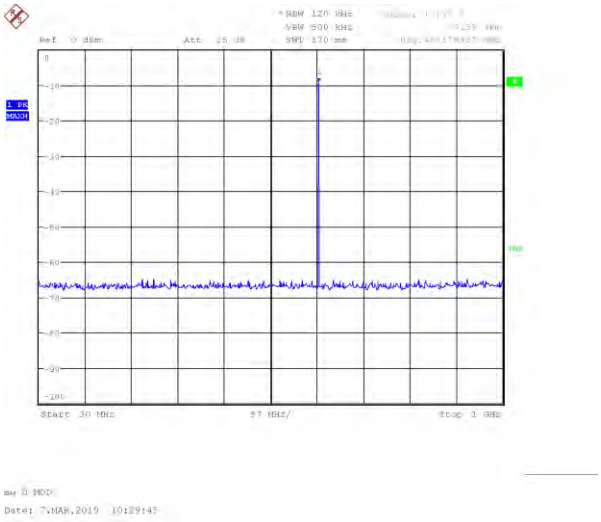
EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	2.1051 Spurious Emissions at Antenna Port
Operating Conditions:	High Band, Low Frequency, 614.125MHz, 1mW
Frequency Range	1GHz to 7GHz
Operator Name:	Craig Kozokar
Date Tested:	Tested on March 7, 2019



Appendix E

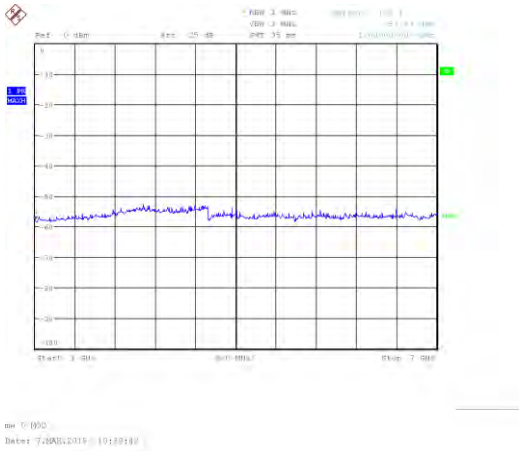
Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	2.1051 Spurious Emissions at Antenna Port
Operating Conditions:	High Band, Low Frequency, 614.125MHz, 10mW
Frequency Range	30MHz to 1000MHz
Operator Name:	Craig Kozokar
Date Tested:	Tested on March 7, 2019



Test Information

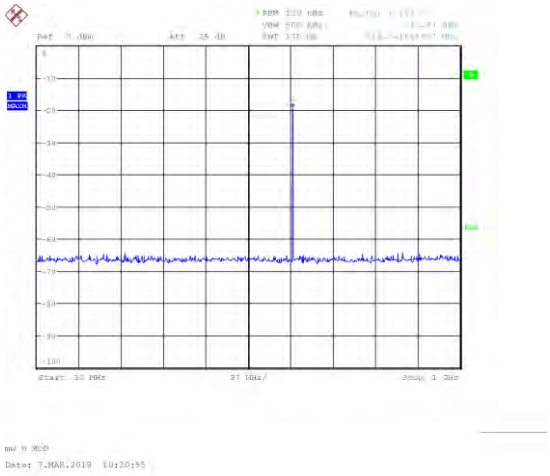
EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	2.1051 Spurious Emissions at Antenna Port
Operating Conditions:	High Band, Low Frequency, 614.125MHz, 10mW
Frequency Range	1GHz to 7GHz
Operator Name:	Craig Kozokar
Date Tested:	Tested on March 7, 2019



Appendix E

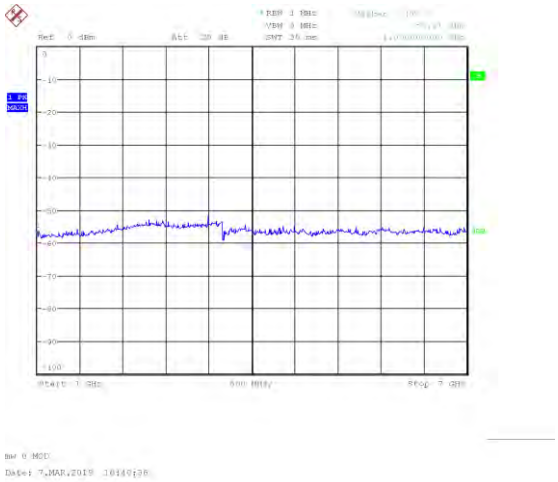
Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	2.1051 Spurious Emissions at Antenna Port
Operating Conditions:	High Band, High Frequency, 615.875MHz, 1mW
Frequency Range	30MHz to 1000MHz
Operator Name:	Craig Kozokar
Date Tested:	Tested on March 7, 2019



Test Information

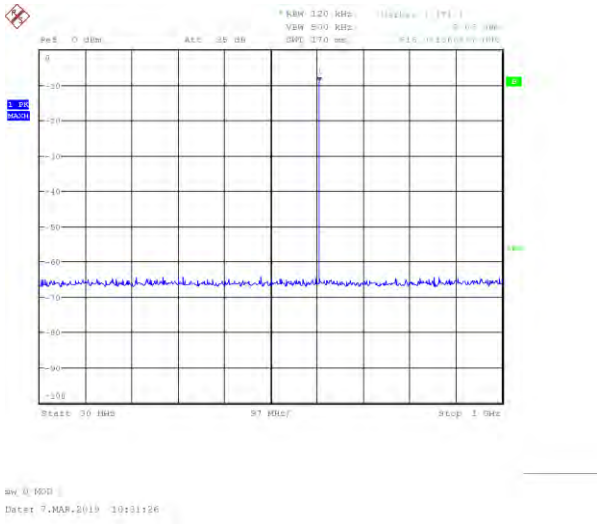
EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	2.1051 Spurious Emissions at Antenna Port
Operating Conditions:	High Band, High Frequency, 615.875MHz, 1mW
Frequency Range	1GHz to 7GHz
Operator Name:	Craig Kozokar
Date Tested:	Tested on March 7, 2019

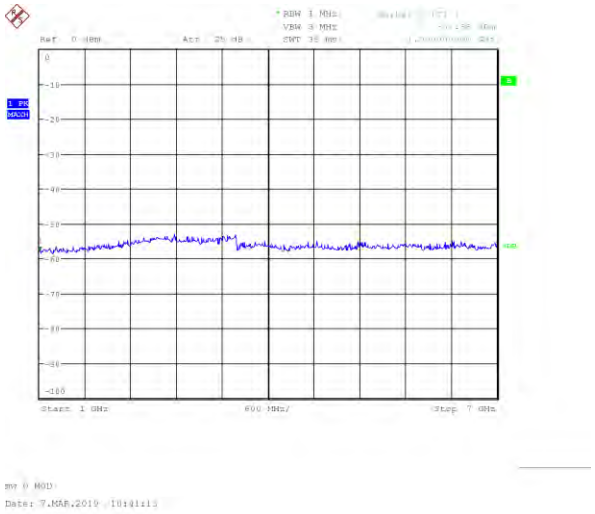


Appendix E

Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	2.1051 Spurious Emissions at Antenna Port
Operating Conditions:	High Band, High Frequency, 615.875MHz, 10mW
Frequency Range	30MHz to 1000MHz
Operator Name:	Craig Kozokar
Date Tested:	Tested on March 7, 2019



Test Information

EUT Name:	ULXD1 J50A
Serial Number:	J5x WMrev02 GC SAMPLE
Test Description:	2.1051 Spurious Emissions at Antenna Port
Operating Conditions:	High Band, High Frequency, 615.875MHz, 10mW
Frequency Range	1GHz to 7GHz
Operator Name:	Craig Kozokar
Date Tested:	Tested on March 7, 2019